Toward an Affective Science of Resource Allocation: Psychological, Affective, and Neural Factors in Resource Allocation Decisions

by

Brian D. Vickers

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Doctoral Committee:

Associate Professor Stephanie D. Preston, Co-Chair
Professor Rachael D. Seidler, Co-Chair
Distinguished Professor Phoebe C. Ellsworth
Assistant Professor Scott Rick
Professor J. Frank Yates

"These, then, are some of the basic principles of ecology—interdependence, recycling, partnership, flexibility, diversity, and, as a consequence of all those, sustainability... the survival of humanity will depend on our ecological literacy, on our ability to understand these principles of ecology and live accordingly."

Fritjof Capra, *The Systems View of Life*

To Savanna

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Abstract

We live an environment where access to material goods is cheap, objects are easy to obtain, and we have an ever-increasing number of options to choose from. The field of decision science has advanced with this pattern, providing a greater breadth and depth of research on how and why people make decisions about material goods. However, our pervading desire to acquire things that we do not need and our failure to reallocate goods and money that may be better used by others (e.g., charities) are understudied. This dissertation investigates these processes, the factors that influence our underlying desire to acquire and our disinclination to discard the things that we do not need, using an appraisal framework.

Three chapters investigate how psychological appraisal patterns, affective disorders, and neural indicators are related to resource allocation. In Chapter 2, we manipulated emotions and appraisal dimensions that have previously been associated with acquisitiveness and found that uncertain appraisals were associated with an increased drive to acquire objects. In Chapter 3, we investigated how chronic emotions are associated with acquisition and found that the combination of depression and anxiety, a high-uncertainty state, was associated with increased acquisition of objects generally, and especially less useful objects that people with hoarding disorders prefer. Chapter 4 investigated factors that influence when people will reallocate their own monetary resources to another at a cost to themselves. We found that vulnerability, high arousal/activation, and their combination led to increased donations to charitable causes. These causes were also differentially associated with brain areas that have previously been associated

with charitable donations (e.g., dorsolateral prefrontal cortex, striatum) and motor-motivational regions that have not been hypothesized by prior models (e.g., premotor area, supplementary motor area).

Together, these studies begin to determine the factors that influence resource allocation decisions, including both the acquisition and discarding of resources. Our approach is also one of the first to explore interactions between emotions and appraisal dimensions that tend to be overlooked in the literature but may lead to unpredicted effects and open avenues to continued scholarship in the decision and affective sciences.

Chapter 1: General Introduction

Consumption is directly linked to environmental problems, but little research addresses the human side of the problem—our pervading desire to acquire, store, and consume energy and resources, even to our detriment. Even when there is a worldwide recession, people still take on debt to fund lifestyles they cannot afford or sustain. In an economically rational world we would stay within our means and take into consideration all the factors involved in our resource allocation decisions, including the impact on the environment. These resource allocation decisions take many forms, from the desire to acquire objects and money to the desire to donate money and objects to others in need.

This dissertation presents studies that investigate how the affective and decision sciences inform our understanding of resource allocation decisions. Resource allocation, as used in this dissertation, is meant broadly with regard to how people invest their time, money, and energy. All of the studies in this dissertation investigate how individual level variables shape the value of options and people's eventual decisions. Chapters 2 and 3 assess how transient and chronic affective states influence people's drive to acquire and keep objects, and demonstrate that uncertain affective states are associated with increased acquisitiveness. However, we also find that when sadness is added to uncertain states it decreases consumption. Chapter 4 investigates how the degree to which we prime action-based concepts and motor-motivational neural circuitry leads to increases in donation behavior, another type of resource allocation. This work finds that charities that elicit more positive feelings of warmth and sympathy lead to higher donations, and

that activating motor-motivational neural systems especially increases donations to these types of charities. Before discussing these studies in more detail, I will give a brief background on the literature motivating these studies.

Decision Making and Preference Construction

Early economic theories of decision making stated that the value or utility that people place on different options is static and unchangeable (Fishburn, 1970; Friedman & Savage, 1948), allowing for strong predictions about stable preferences in consumption patterns. According to these models, suppose A > B denotes that A is preferred to B. Then if an individual prefers A > B, and B > C, then they necessarily prefer A > C. This makes sense with easily exchangeable formats such as money. A person who prefers $100 > $50, and $50 > $10 should always prefer $100 > $10. These theories hypothesize that preferences are consistent across domains and invariant to response formats and framing.

However, in the 1980s and 1990s, researchers testing the stability and structure of people's preferences found that there were inconsistencies that violated almost all theories of preference, including expected utility theory. In these experiments people were offered a choice between a gamble with a high chance of winning a low amount of money (P bet) or a low chance of winning a high amount of money ($ bet). People typically prefer the P bet in a forced choice (i.e., choose P bet or $ bet) but bid a higher amount of money to obtain the $ bet compared to the P bet. This is what is referred to as a *preference reversal*, when preferences for options are flipped after a contextual, response (e.g., P or $ bet), or other change that does not influence objective characteristics of the options. A preference reversal occurred here because people preferred

(P bet) > ($ bet) with one response format, forced choice, and preferred ($ bet) > (P bet) in another response format, bidding, even though their expected values remained unchanged. These refutations of the traditional decision framework have led to the current consensus in the field that values are constructed on the spot per the existing context rather than fixed and invariant across contexts. Similar to the shift in the valuation of options depending on the response format, emotions can alter preferences (e.g., Raghunathan, Pham, & Corfman, 2006) and the values of options (e.g., Cryder, Lerner, Gross, & Dahl, 2008; Lerner, Li, & Weber, 2012).

Moving from a normative analysis specifying what people *should do* to a descriptive analysis specifying what people *actually do*, extant research has shown additional deviations in how people make decisions under uncertainty. First, probability information is not evaluated objectively but is evaluated on a subjective basis (Kahneman, 1979). When given choices between gambles, people overweight small likelihoods of events occurring and underweight high likelihoods of events occurring. Second, people do not treat gains and losses of the same objective magnitude in the same way. Losses have a greater impact on utility, meaning that the positive impact of $10 has about the same absolute utility as a loss $5. This is sometimes described by the saying, "losses loom larger than gains," and is important to keep in mind in the following discussion of affect and decision making.

Affect and Appraisals

Most theories of emotion acknowledge that emotions arise in response to cognitive evaluations of events that signal information about the self, and interactions between the self and the environment (Ekman & Davidson, 1994; Frijda, 1993; Lazarus, 1991; Scherer, Schorr, & Johnstone, 2001). Through signaling important and relevant information, emotions help

individuals navigate the physical and social environment. Functionally, emotions direct attention and shift cognitive and physiological resources quickly from one task to another. Simon (1967) describes emotions as cognitive "interrupts" that suppress ongoing actions in lieu of high-priority, emotion-relevant actions. Emotions also organize sets of responses that facilitate adaptive responding (Oatley & Johnson-Laird, 1987), such as disgust helping individuals avoid objects that could lead to illness or harm (Cosmides & Tooby, 2000; Nesse, 1990; Nesse & Ellsworth, 2009).

The exact cognitive processing of these appraisals vary, with some being relatively automatic and happening quickly, and others taking more cognitive resources and occurring later. For example, judgments of valence (i.e., is this good or bad?) happen relatively automatically and quickly while judgments of control (i.e., what can I do?) take significantly more time and cognitive resources (Gentsch, Grandjean, & Scherer, 2013).

The above two appraisal dimensions, valence and control, are two of approximately six major appraisal dimensions. In a recent, worldwide study that examined multiple affective indicators of emotions (Fontaine, Scherer, Roesch, & Ellsworth, 2007), support for four major appraisal dimensions was found. These dimensions included pleasantness (i.e., the degree that one feels pleasure versus displeasure), certainty (i.e., the degree to which future events seem predictable and comprehensible versus unpredictable and incomprehensible), control (i.e., the degree to which events seem brought about by individuals versus the situation), and arousal/activation (i.e., the degree to which physical or bodily arousal is activated; though other dimensions are discussed in Frijda, 1993; Roseman, 1991; Smith & Ellsworth, 1985).

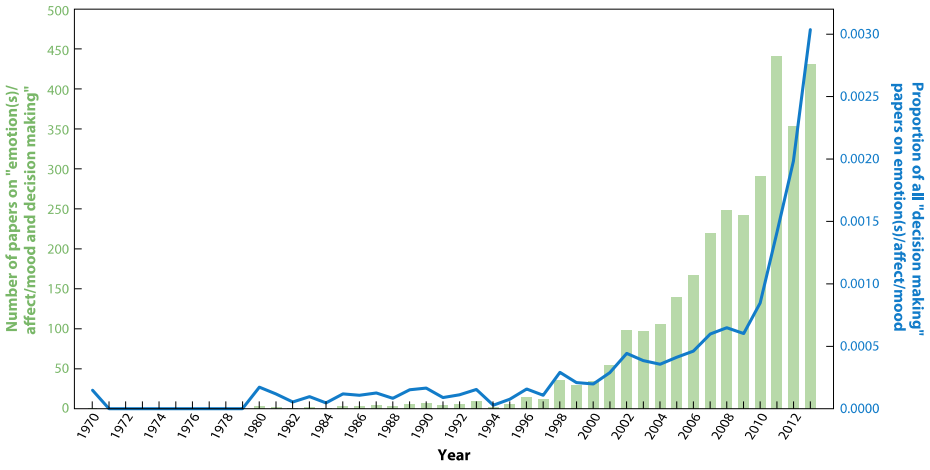
In appraisal frameworks, different emotions are classified by existing at different points on these appraisal dimensions. For example, one study had subjects recall experiences of 16

different emotions and rate those experiences across a number of dimensions (Smith & Ellsworth, 1985). This study was able to characterize different emotions across the appraisal dimensions. They found that fear was associated with feelings of unpleasantness, uncertainty, and low self-responsibility. On the other hand, anger was associated with feelings of unpleasantness, certainty, and low self-responsibility. Importantly, while fear and anger are similar on some dimensions (unpleasantness, low self-responsibility), fear is associated with a sense of uncertainty whereas anger is associated with a sense of certainty.

Affect and Decision Making

Recently there has been a rise in studies exploring the connection between emotions and decision making (see Figure 1.1, taken from Lerner et al., 2015). It is important to first describe the differences between (a) integral compared to incidental emotion, (b) valenced accounts of emotions on decision making, and then (c) the appraisal approach to explaining how emotions influence decision making.

Figure 1.1. Number of scholarly publications from 1970 to 2013 that refer to "emotion(s)/affect/mood and decision making" (*green bars*) and proportion of all scholarly publications referring to "decision making" that this number represents (*blue line*). Taken directly from Lerner, Li, Valdesolo, & Kassam (2015).



Integral Emotions and Decision Making

Integral emotions refer to emotions that are related to the decision at hand. For example, imagine that you are walking home and trying to decide whether to take a shortcut through an alley. As you look down the alley, you see that most of the lights are out and notice the silhouette of a person in the darkness, filling you with anxiety and a sense of danger. The anxiety is integral to the decision because it pertains to the decision at hand; your evaluation of the alley is causing negative feelings that suggest that the alley is unsafe and that you should not proceed. For the most part, theories of integral emotions have focused on risk assessments and decision making.

Two of the most influential theories of integral emotions are the Somatic Marker Hypothesis (SMH; Bechara & Damasio, 2005; Bechara, Damasio, Tranel, & Damasio, 1997) and Risk as Feelings theory (Loewenstein, Weber, Hsee, & Welch, 2001). The SMH proposes that valenced affective "markers" are attached to stimuli and outcomes that indicate whether they are beneficial or harmful to the self. Evidence for the SMH comes largely from studies of the Iowa Gambling Task (IGT), where subjects make decisions between four decks of cards. Subjects are given a fixed amount of money to begin the task and each card that they choose results in earning or losing money. Two of the decks result in long-run losses and two other decks result in long-run gains. In the initial study (Bechara et al., 1997), subjects began to make advantageous decisions about which deck to choose from before they could articulate why they were choosing from that deck, and this was accompanied by activation of the sympathetic nervous system (as measured by skin conductance responses; SCRs). A number of studies have been published on this work since then (reviewed in Bechara & Damasio, 2005), including specifying the underlying neural substrates of the process.

Lesion studies, where subjects with focal lesions to parts of their brain are selected to participate, have differentiated the neural substrates underlying the creation of these somatic markers and their integration into the decision process. The amygdala is necessary for the production of somatic markers, since lesions to the amygdala lead to a cessation of SCRs (Bechara, Damasio, & Damasio, 2006). Lesions of the ventral medial prefrontal cortex (vmPFC) and the orbitofrontal cortex (OFC), on the other hand, are associated with subjects producing skin conductance responses but failing to decide advantageously in the IGT (Bechara, Tranel, & Damasio, 2000). This has led the authors to conclude that the amygdala is necessary for the production of somatic markers and that the vmPFC/OFC are necessary for the integration of these signals into the decision process.

The Risk as Feelings hypothesis (Loewenstein et al., 2001) is not a neuroscientific theory, but focuses on how affect can inform decision theory. The main point of their argument is that risk assessments are not done through cold, cognitive calculation and evaluated using overall measures such as expected value. Instead, evaluations of risk operate through parallel routes, one being cognitive and more rational and the other being emotional and more implicit. Importantly, when these two streams diverge, Risk as Feelings suggests that greater weight is placed on the affective input. For example, people with phobias of flying know that the objective risk of harm when flying on a plane are extremely low, nevertheless they are unwilling to board a plane without clinical interventions (Laker, 2013). This is because some calculations are done differently by the cognitive and affective systems: the cognitive system weights probabilities relatively objectively while the affective system weights probabilities by the vividness of outcomes and is relatively insensitive to objective probabilities.

Incidental Emotions and Decision Making

In contrast to integral effects of emotions on decision making, incidental effects occur when emotions that are unrelated to the decision at hand systematically influence or bias the decision making process. Recall the example where you are walking home and trying to decide whether to take a shortcut through an alley. If your doctor called you earlier for an immediate appointment and this is making you anxious about your health, then the anxiety could carryover and lead you to avoid the shortcut through the alley, just like integral anxiety did. Incidental emotions are thought to produce the same effects as integral emotions, though differences between the two are rarely investigated.

General Theories of Carryover Effects

Feelings-as-Information theory (Schwarz, 2012; Schwarz & Clore, 1983) takes a valenced approach to explaining emotion carryover effects, including incidental effects. Feelings-as-Information theory argues that when people are making decisions and assessments, they incorporate how they feel about outcomes into the decision process. So when people are making choices about objects they ask things like, "How does this object make me feel (i.e., pleasure or displeasure)?" When making evaluations of individuals they ask, "Do I like this person or dislike this person?" This model accounts for incidental carryover effects depending on where feelings are attributed. If people do not attribute their mood to something else then they can misattribute that affect toward unrelated judgments. As an early test of this theory, participants who were called on sunny days and were presumably in a positive mood reported higher life-satisfaction than participants who were called on rainy days and were presumably in a

more negative mood. However, by slightly tweaking the procedure and asking participants about the weather before asking about their life-satisfaction, causing them to attribute their positive or negative feelings to the weather, this effect completely disappeared (Schwarz & Clore, 1983). In other words, affect only carried over to evaluations of life-satisfaction when people did not think about their affect as due to the weather.

The Feelings-as-Information theory accounts for a great deal of emotional carryover effects, but cannot account for effects within the same valence. The Appraisal Tendency Framework (ATF; Han, Lerner, & Keltner, 2007; Lerner, Han, & Keltner, 2007; Lerner, 2000) builds upon appraisal theories of emotion in order to link emotions to specific decision making effects. According to appraisal theories, people feel emotions because they appraise situations using the appraisal dimensions, such as appraisals of anger being derived from negative events that are perceived to be predictable and caused by others. The ATF proposes that when people are feeling emotions they are pre-disposed to appraise new events and situations with the central appraisal dimensions triggered by the felt emotion(s) (Lerner, Li, Valdesolo, & Kassam, 2015). So, when people are angry they are more likely to appraise new negative events as being predictable and caused by others. Indeed, this is the case.

Numerous studies have drawn upon the ATF and shown varying effects from emotions of the same valence, as well as similar effects from emotions of the opposite valence. When angry (a human-agency emotion), people expect ambiguous events to be caused by other individuals compared to when sad (a situational-agency emotion), where people expect ambiguous events to be caused by the situation (Keltner, Ellsworth, & Edwards, 1993). Similarly, inducing people into a state of anger results in more optimistic risk judgments than those generated by people in a fearful state (Lerner, 2001). This study also found that appraisals of control fully mediated the

link between emotion state and risk estimates, supporting the causal pathway proposed by the ATF. The ATF is the general framework drawn upon in this dissertation.

Table 1.1. Definitions of common emotion terms.

Term	Definition
Affect	Unspecified feelings, or the overarching term for constructs involving emotion, moods, and emotion-related constructs
Valence	The negative or positive value/pleasantness of an affective state
Emotion	Affective responses to specific events that are usually shorter in duration than moods, and are associated with specific cognitive appraisals
Mood	Affective responses to unspecified events that are longer in duration than emotions and more diffuse
Integral emotion	Feelings that are associated with a current decision at hand
Incidental emotion	Feelings that are associated with events unrelated to the current decision at hand; may unknowingly influence the current decision
Appraisal	Process that detects and assesses the significance of the environment for well-being
Appraisal theme	Summary of specific harms/benefits that may arise in the environment, which influences coping behaviors
Appraisal tendency	Process by which an individual uses their current appraisal state (i.e., place on each appraisal dimension) to appraise new situations in similar ways

The Current Research

Resource allocation is primarily composed of two types of decisions: Decisions to acquire or accumulate, and decisions to discard or expel. It could be argued that decisions to keep objects are another type of resource allocation decision, but this framing runs into certain problems. Once resources are acquired, action is not typically required in order for them to be retained, but action is typically required in order for resources to be discarded. In this sense,

retention of objects will be treated as failure to discard rather than as a separate process. Importantly, failure to discard can reflect a dislike or inability to get rid of an object (e.g., fear of not having it when necessary) or satisfaction and positive feelings toward owning an object.

Current research suggests that acquisition and discard decisions are separable and associated with different underlying cognitive, affective, and neural processes. Compulsive spending is associated with the inability to control impulses to spend, but not with an inability to discard or get rid of things that are currently owned (American Psychiatric Association, 2013). Neuroimaging work has shown a double dissociation, with acquisition decisions activating the OFC more than discard decisions, but discard decisions activating the dorsolateral prefrontal cortex more than acquisition decisions (Wang, Seidler, Hall, & Preston, 2012). It is possible to spend a whole career researching either of these processes, and this dissertation only begins to investigate the dynamics of acquisition and discard processes.

The work conducted in this dissertation is motivated by work with Dr. Stephanie Preston, and touches upon both acquisition and discard decisions. Chapters 2 and 3 investigate acquisition behaviors while Chapter 4 investigates discard behaviors. Chapter 2 applies the ATF to acquisition decisions to explore how certainty is associated with the acquisition of objects. This work uses an emotion induction paradigm to make participants feel anxiety, a low certainty emotion, or sadness, an emotion typically high in certainty. The experimental manipulation of emotions allows us to directly observe whether increases in either emotion lead to increases in the amount of objects that subjects are driven to acquire. Results indicated that people induced to uncertain affective states acquired more objects than sad or neutral people, and paid more for useful objects than pleasurable objects. We also found that people who only felt uncertainty accumulated more objects, but people who felt both uncertainty and sadness acquired fewer

objects. This suggests that when uncertainty and sadness are combined then appraisals of certainty associated with sadness may blunt the effects of uncertainty (Winterich, Han, & Lerner, 2010), or that combined uncertainty and sadness may lead to an emergent affective state unrelated to shifts on appraisal dimensions (Kreibig, Samson, & Gross, 2013).

Chapter 3 investigated whether similar results were apparent in individuals with chronic affective disorders. This study used a large-scale survey across people with a variety of chronic affective disorders to assess the types of objects that people were motivated to acquire and keep. Packrats, people with the highest chronic drives to acquire and retain goods, were especially interested in low-value items that could be repurposed, reused, or given to others when they need them, as well as social items used in the home. Participants with affective disorders were generally disinclined to acquire objects compared to controls, especially memorabilia. We also examined more natural affect in patients suffering from psychiatric conditions by clustering them using scales assessing cognitive and affective individual differences. This approach showed that subjects feeling combined anxiety and depression were disinclined to acquire the scrap items packrats were drawn toward, an effect similar to the decreased acquisition of subjects feeling uncertain and sad in Chapter 2.

Instead of investigating acquisition decisions like we did in Chapters 2 and 3, in Chapter 4 we investigated how people make decisions to donate monetary resources. Participants viewed numerous charities and made decisions to allocate monetary resources by donating any amount of their earned money to these charities. We varied the types of emotions elicited by the charities (e.g., less or more nurturant, warm, compassionate feelings) and the level of action that was required to help (e.g., passive or active helping activities). Charities that elicited more warm, compassionate feelings received higher donations from participants, and these more nurturant

charities received an extra donation boost as they elicited higher arousal appraisals. The more nurturant charities eliciting high arousal also activated a network of brain regions identified in previous studies of charitable donations, including the dorsolateral prefrontal cortex, striatum, and premotor areas.

Taken together, these chapters demonstrate that affective factors influence both resource allocation decisions to acquire as well as to retain and discard resources. This dissertation showcases a variety of approaches to understanding affective influences on resource allocation decisions, including affect manipulation, affect measurement, and the use of ecological clustering on affective factors. Beyond demonstrating that affect influences resource allocation decisions, this work also suggests that interactions between appraisal dimensions may produce unpredicted effects (Chapters 2 and 3) that do not fit into existing frameworks for understanding emotions and decision making. This dissertation demonstrates that emotions and appraisal dimensions—like sadness, anxiety, and uncertainty—can interact in unexpected ways that require new theories (e.g., tests of emotional blunting versus unique mixed affective states, Kreibig et al., 2013; Winterich et al., 2010), to allow us to better prescribe decision making strategies and decision aids for sustainability, finance, and well-being.

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Chapter 2: Affective Influences on the Drive to Acquire: Uncertainty and Sadness Increase Consumption, but Uncertain-Sadness Does Not

Abstract

Current research is rapidly discovering ways in which emotions influence people's preferences and willingness to pay, but there is no work investigating its influence on people's overall drive to acquire and consume. Uncertainty about the future is associated with many problems of acquisition and consumption including hoarding disorder, increased eating in dieters, and even increased stockpiling in hoarding mammals. Due to these links, we hypothesized that uncertainty would cause people to acquire an increased *quantity* of objects in order to cope with uncertain future threats. To investigate this possibility we induced emotions varying in their level of uncertainty and measured subjects' acquisition patterns on a computerized object decision making task. In two studies we found that high uncertainty states including anxiety (Study 1) and an uncertain form of sadness (Study 2) led subjects to acquire an increased *quantity* of objects compared to subjects feeling more certain forms of sadness. These effects persisted in spite of emotions not influencing evaluations of anticipated pleasure or perceived usefulness of the items.

Keywords: Emotion, decision making, uncertainty, anxiety, sadness, consumption

Introduction

Acquisitiveness, the drive to acquire and consume objects, varies continuously within the population (Timpano et al., 2012; Vickers & Preston, 2014) but has been neglected in the decision making literature. Our purchasing and ownership has led to a 100-fold increase in the required storage space of Americans since the 1980s (Drentea, 2000; Self Storage Association of America, 2013), but it is unlikely that anything in the past 30 years has made us *need* these extra things. To help people spend within their means, avoid unnecessary debt and stresses, and decrease our impact on the environment, we need to understand how acquisitiveness functions.

Recent research on emotions and consumption decisions has focused on preference shifts and willingness to pay (WTP), but not the underlying drive to acquire and consume generally. Research suggests that emotions associated with acquisition and cost are dissociable. Emotions associated with acquisition tend to be positive (e.g., thinking about getting a great dinner) whole emotions associated with costs tend to be negative (e.g., thinking about not being able to buy a new phone) (Prelec & Loewenstein, 1998; Rick, Cryder, & Loewenstein, 2008). Therefore, while emotions that lead to increased WTP may lead to similar effects on the drive to acquire, it is not necessarily the case.

More strong evidence of a dissociation between anticipatory emotions and payment computations comes from a functional magnetic resonance imaging (fMRI) study (Knutson, Rick, Wimmer, Prelec, & Loewenstein, 2007). When subjects are given choices to purchase or not purchase products while in the scanner, different neural circuits are involved in the initial valuation of objects, and separate neural circuits come online to incorporate pricing and come to a final decision. Product preferences prior to pricing information activated reward-related circuitry (the nucleus accumbens), but decisions to purchase moderated activation of the mesial

prefrontal cortex, an area associated with higher-level cognitive computations and the integration of value signals from multiple areas of the brain (Chib, Rangel, Shimojo, & O'Doherty, 2009; Plassmann, O'Doherty, & Rangel, 2007). Thus, evaluation and payment calculations are dissociable. The present studies aimed to understand the ways that emotions influence people's acquisitiveness and WTP, beginning with uncertainty due to its documented associations with consumption.

In the literature, anxiety, a high uncertainty emotion, and sadness, a high certainty emotion, have both been implicated in the human drive to consume. Both transient states of anxiety (Lerner, 2001) and having an anxious personality (Schaninger, 1976) lead to increased perceptions of risks and uncertainty in the environment, perceptions that are associated with increased acquisition in individuals with hoarding disorder (Steketee & Frost, 2003; Steketee, Frost, & Kyrios, 2003). Hoarding disorder has a high comorbidity with anxiety disorders (Frost, Steketee, & Tolin, 2011), and surveys of hoarding symptoms correlate with higher intolerance of uncertainty (Holaway, Heimberg, & Coles, 2006). In related work in animals, hoarding mammals gather and retain larger hoards in more uncertain, more variable environments (e.g., high latitudes; Preston & Jacobs, 2001, 2005; Vander Wall, 1990). One study also found that anxiety increased preferences for more useful objects (Raghunathan et al., 2006). These studies lead to the hypothesis that uncertain individuals should acquire more objects overall, and that this increased acquisition may be focused on useful objects.

Sadness, on the other hand, is typically associated with certainty (Fontaine et al., 2007; Smith & Ellsworth, 1985), but can increase reward motivations and consumption. Inducing sadness in people leads to preferences for rewarding social contact over instrumental social contact (Forgas, 1991); causes people to eat more palatable, hedonic foods compared to happy

subjects (Garg, Wansink, & Inman, 2007); and causes people to prefer more comfortable, rewarding products (Raghunathan et al., 2006). Additionally, sadness increases participants' WTP (Cryder et al., 2008), though this only affected self-focused individuals. Many of these authors have suggested a mood-maintenance hypothesis, that sadness motivates people to put themselves into a better mood, and that this can be accomplished by social interaction or by acquisition of objects. A direct link between the motivation to boost mood and purchasing comes from retail therapy, the proclivity to purchase planned or unplanned "treats" for mood-improvement (Atalay & Meloy, 2011). None of these studies have suggested an increase in overall rates of acquisition, and since a single mood-improving treat may be enough to boost people's affective state we did not hypothesize that sadness would increase overall acquisitiveness. However, the mood-boosting hypothesis suggests that a disproportionate number of the total acquired objects would have more hedonic qualities that might put people into a better mood.

We created three item categories to test our hypotheses. We created a set of "functional" items high in usefulness to test the hypothesis that uncertain emotions would lead people to disproportionately prefer them. Another set of "hedonic" items high in desirable, pleasurable qualities were created to test the hypothesis that sadness would lead people to disproportionately prefer them in order to improve their mood. Since functional and hedonic items contained tradeoffs on the other dimension, neither were objectively superior (i.e., better on both useful and hedonic qualities). In naturalistic settings, the "best" items that could potentially lead to the greatest positive impacts on people's mood would be superior on both attributes. To better approximate this superior category of objects we included objects that were high on both usefulness and pleasurable qualities, hereafter referred to as "premium" items.

In Study 1, participants were induced into an uncertain (anxious), certain (sad), or neutral emotional state by reading and empathizing with a story. Participants then performed a computerized object decision task (ODT; Preston, Muroff, & Wengrovitz, 2009) where they were told that they could receive items that they selected in the task. We found that uncertainty increased the quantity of objects acquired by subjects, but certainty did not influence the level of objects that subjects acquired. Since sadness can vary from uncertain to certain, in Study 2 we sought to ascertain whether sadness could lead to increased consumption if it were accompanied by more uncertain appraisals. Subjects were induced into an uncertain-sadness, certain-sadness, or neutral state before measuring acquisition on the ODT. Even when all emotional subjects read a sad story, uncertainty increased overall consumption. The effect of uncertainty increasing consumption was moderated by an unexpected interaction: uncertainty only increased consumption for subjects who reported low levels of sadness.

Study 1

Methods

Participants. One hundred ten (110; mean age = 19.21 years, *SD* = 1.51; *N* = 50 females) University of Michigan undergraduates and people from the local community participated in the study, and were compensated with introductory psychology course credit or $10 for their time, respectively. The total duration of the study was approximately one hour. Six subjects were removed from analysis: three due to computer errors, two due to reporting they did not feel the emotions in the story during a post-task interview, and one that did not follow instructions.

Procedure

Upon entry to the lab, subjects were told a cover story that multiple researchers had combined two separate studies to fit into the one hour of testing time. The first was purported to

examine responses while empathizing with stories. Subjects then went through an emotion induction and were re-consented for a study investigating object preferences. They then performed the ODT, filled out personality questionnaires, and were debriefed.

Emotion induction. To induce a specific emotion, subjects were randomized into one of three emotion conditions (anxiety, sadness, or a neutral state). Emotions were manipulated by having subjects read stories that were approximately one page in length. Subjects were instructed to mentally step into the shoes of the main character in the story and imagine the situation as vividly as possible, as if the story were happening to them. Stories were adapted from Raghunathan et al. (2006). Sad subjects (mean age = 19.25, *SD* = 1.27, *N* = 37, 18 females) read a story about the death of their mother, anxious subjects (mean age = 18.81, *SD* = 0.89, *N* = 37, 16 females) read about being called by their doctor to discuss an unnamed health problem, and neutral subjects (mean age = 19.63, *SD* = 2.18, *N* = 33, 14 females) read about performing daily activities such as brushing their teeth and riding the bus. Subjects were given five minutes to empathize. To measure subjective differences in emotion, subjects rated 28 emotion adjectives (adapted from the PANAS; Watson, Clark, & Telegren, 1988) both before empathizing with the stories and immediately following the empathy task on a scale ranging from (1) "Not at all" to (5) "Extremely." To ensure that the empathy task induced the desired emotions, we used composite scores created with three items per emotion (as in ` Cryder et al., 2008; Raghunathan et al., 2006). Sadness composite scores were computed by averaging the ratings of "blue," "sad," and "depressed;" anxiety was scored as the average of "anxious," "nervous," and "worried;" and neutral scores were created using the adjectives "indifferent," "neutral," and "unemotional." None of these terms appeared in any of the empathy stories.

In order to increase the credibility of the cover story that the empathizing task was a stand-alone study that was unrelated to the ODT, subjects also filled out a face valid five item "Empathy Questionnaire" that we created. Items assessed whether they could relate to the story and how easy it was to empathize with the situation (e.g., "I felt myself getting emotional as I read the passage," and, "I was able to step into the shoes of the main character").

Object decision task. Following the emotion induction procedure, subjects were told that the researcher conducting the second study was interested in decision making about objects. All subjects were re-consented and given instructions for a one-block version of the ODT (Preston et al., 2009). Subjects saw a variety of objects and were instructed to imagine that they were being offered to them for free on their testing day. Their task for each object was to respond "acquire" if they would keep the hypothetical item for free, or respond "do not acquire" if they would not take that object home for free. This procedure was used to measure acquisitiveness without confounds associated with price. Items remained on the screen until subjects made a response, and there was an ITI of 3 seconds. To help elicit subjects' true acquisition behaviors, we informed subjects that we were having a raffle where 10 items that people said they would acquire would really be given to participants for free. After a practice round with 6 unrelated items, subjects continued to the full block of items.

ODT item selection. Selection of object stimuli for the ODT was based on objects' functional and hedonic attributes. Functional, hedonic, and premium item categories each consisted of 16 items, eight of which were foods and eight were non-foods, for a total of 48 trials per subject for analysis (see Table 2.2 for a full list and ratings, described below).

Item ratings. After subjects performed the ODT they rated multiple dimensions of each item. For the first two dimensions, they rated how hedonic (e.g., pleasurable to have/consume it;

think obtaining it would make them happy) and useful (e.g., would come in handy; could be used in many situations) each item was. Additionally, we recorded how much subjects thought the items would cost in a store, and how much they would be willing to pay if the item was available for their purchase on the day of testing.

Personality questionnaires. Before debriefing, subjects also filled out questionnaires about how hungry they were (Friedman, Ulrich, & Mattes, 1999); the savings inventory, revised, which measures the degree of overacquisition, failure to discard, and clutter as symptoms of problematic hoarding behaviors (Frost, Steketee, & Grisham, 2004); the obsessive compulsive inventory, revised (Foa et al., 2002), which measures multiple dimensions of obsessive compulsive disorder including hoarding symptoms; and the Beck depression inventory II (Beck, Steer, & Brown, 1996), which measures the degree that subjects are currently experiencing depressive symptoms. None of these surveys interacted with group responses so they are not discussed below.

Analysis

Manipulation checks were conducted using repeated-measures ANOVAs. Changes in composite emotion scores (post- minus pre-emotion induction) were used as the dependent variables with story type (anxious, sad, neutral) as a between-subject factor. Item validation was conducted using an ANOVA with averaged ratings on how hedonic and useful each object was, with object category (functional, hedonic, premium) entered as the grouping factor.

Performance on the ODT was analyzed using the percentage of the total items in each category acquired as the dependent variable. Differences in acquisition, WTP, and item ratings were estimated using a mixed ANOVA with emotion group (anxious, sad, and neutral) as a between-subject factor, and within-subjects factors for item type (functional, hedonic, premium)

and whether items were consumable (non-foods, foods). All post-hoc tests were corrected with Tukey's Honestly Significant Differences. The alpha threshold for significance was set at .05.

Results

Manipulation check. The omnibus test on composite emotion change scores revealed a significant difference in emotions across groups due to the anxious group increasing in anxiety compared to the neutral group, and the sad group increasing in sadness compared to the neutral group, omnibus: $F(4,172) = 10.09$, $p < .001$; all contrast p's < .05).

Item validation. Our *a priori* item categories (functional, hedonic, and premium) differed in how hedonic and useful they were, omnibus: $F(2,45) = 56.43$, $p < .001$. Confirming our characterization of these categories, post-hoc tests showed that hedonic and premium items were more hedonic than the functional items. Also, functional and premium items were more useful than hedonic items, all p's < .01. Premium items did not differ from hedonic items on the hedonic scale, nor did premium items differ from functional items on the usefulness scale, as desired. Item types did not differ on perceived price, ruling out the explanation that any item category was taken only because it was perceived as more expensive, omnibus: $F(2,45) = 0.10$, *ns*.

Object Decision Task. In line with our hypothesis, anxious subjects took more items overall, main effect of emotion group: $F(2,103) = 4.50$, $p = .013$. Post-hoc tests showed anxious subjects took more than sad and neutral subjects, but sad subject did not take more than neutral subjects, $M_{anxious\text{-}sad} = 11.91$, $p = .020$; $M_{anxious\text{-}neutral} = 10.89$, $p = .044$; $M_{sad\text{-}neutral} = -1.02$, $p = .98$. The interaction between emotion group and item type was not significant, item type by emotion group interaction: $F(4,206) = 1.29$, $p = .27$, but repeated-measures ANOVAs across the three groups within each item type found that anxious subjects took more items with functional

attributes (functional and premium items, but not hedonic items) than the other two groups, emotion group main effect in Functional items: $F(2,103) = 4.72$, $p = .011$, $\eta_p^2 = 0.084$; emotion group main effect in Premium items: $F(2,103) = 4.70$, $p = .011$, $\eta_p^2 = 0.084$; emotion group main effect in Hedonic items: $F(2,103) = 1.29$, $p = .279$; $\eta_p^2 = 0.024$). Mean rates of acquisition are listed in Table 2.1.

Item types differed in how often they were acquired by subjects, item type omnibus: $F(2,206) = 94.16$, $p < .001$. Premium items were acquired most, hedonic items a moderate amount, and functional items least, post-hoc *p's* < .001.

Table 2.1. Percentage of items taken (standard error) split by group and item type.

		Item Type		
Group	Overall	Functional	Hedonic	Premium
Sad	37% (2.96%)	24% (3.23%)	41% (3.87%)	45% (3.69%)
Anxious	50% (3.66%)	37% (4.95%)	50% (4.04%)	63% (3.95%)
Neutral	38% (3.68%)	22% (3.74%)	22% (4.54%)	53% (4.65%)

Willingness to pay. There were no overall differences in WTP between groups, but there was a marginal interaction between group and item type, main effect of group: $F(2,103) = 0.25$, $p = .783$; group by item type interaction: $F(4,206) = 2.08$, $p = .085$. Within each group, we ran pairwise comparisons with Bonferroni corrections (adjustment denoted p_{adj}) and found that anxious and sad subjects were willing to pay higher prices for premium than hedonic items (anxious: $p_{adj} > .018$; sad: $p_{adj} > .009$). However, *only* anxious subjects were willing to pay more for functional than hedonic items (anxious: $p_{adj} = .027$, sad and neutral: $ps_{adj} > .99$). Uniquely, sad subjects had marginally higher WTP for premium over functional items ($p_{adj} > .054$). The

neutral group showed no pairwise differences. There were no group differences in each item type separately, and no other group interactions in the model reached significance, *p*s > .275.

Similar to the acquisition analysis, WTP was higher for premium items than functional items, $F(2,206) = 18.87$, $p < .001$. WTP for hedonic items did not differ from either of the other two item types, $p > .25$. WTP was also higher for non-foods than foods, $F(1,103) = 125.62$, $p < .001$.

Object ratings. Emotion groups did not differ in their overall ratings of object desirability or usefulness, emotion group main effect on desirability ratings: $F(2,103) = 1.49$, $p = .231$; emotion group main effect on usefulness ratings: $F(2,103) = 1.97$, $p = .144$; all group interactions *ns*.

Discussion

Based on links between uncertainty, anxiety, and acquisitiveness, we hypothesized and found evidence that subjects feeling an uncertain emotion, anxiety, acquired about 10% more objects than subjects feeling sad or neutral. In line with a previous study showing that anxiety leads to increased importance placed on usefulness in the decision process (Raghunathan et al., 2006), anxious subjects acquired more objects with higher levels of usefulness (functional and premium items), but not items low in usefulness (hedonic items). Sadness did not lead to increases in overall acquisitiveness. We did not find support for our hypothesis that it would lead to increased preferences for desirable, hedonic items. Anxious subjects who acquired more items with functional attributes also assigned a higher WTP for functional than hedonic items, suggesting anxiety may produce effects at both levels. Sad subjects had a directionally higher WTP for the best items (premium items) compared to functional items, suggesting that they may value the best items more than those with the lowest possibility of boosting their mood.

However, the effect was only marginal so patterns should be replicated in order to establish the stability of the difference.

While the manipulation check verified that the sadness induction was successful and was stronger in statistical power than the anxiety induction (sad $\eta_p^2 = 0.37$, anxious $\eta_p^2 = 0.19$), we did not find any effects of sadness on the overall number of items acquired by sad subjects. Additionally, we only found a small effect of sadness on WTP. In the prior work demonstrating that sad subjects were willing to pay more they did not investigate any differences across item types and they only found effects for subjects who self-focused (Cryder et al. (2008). Our induction used the same story between subjects and did not allow us to measure levels of self-focus, making it difficult to know whether our self-focused sad subjects were driving differences in WTP.

To investigate why we did not find effects of sadness and its relationship with acquisitiveness, we capitalize on the fact that sadness may vary from high to low uncertainty. This within-emotion variability can lead to changes in information processing and behavioral outcomes (Tiedens & Linton, 2001). Using our stories, the passing of a loved one is likely to elicit certainty along with feelings of sadness, whereas a living but sick loved one with uncertain chances of survival is more likely to elicit uncertainty along with feelings of sadness. Study 2 aimed to investigate whether higher uncertainty within sadness also activates mechanisms to cope via increased object acquisition.

Study 2

We devised two new stories to induce uncertain-sadness, certain-sadness, or a neutral state before participants made acquisition decisions. As with anxiety, which typically involves high uncertainty, we expected that sadness would increase the quantity of objects acquired when

accompanied by feelings of uncertainty, but not when accompanied by feelings of certainty. We hypothesized that certain-sadness would be more similar to the sadness induced in our first study; thus, it was not hypothesized to increase the overall number of objects acquired.

Methods

Uncertain and certain stories pre-test. To reliably induce uncertain or certain sadness we modified the sad story about the death of your mother from Study 1 (full stories in the appendix). To confirm that the stories would elicit differing levels of uncertainty, a sample of 34 participants from an online US sample were asked to empathize with one of the two modified stories as in Study 1. Afterward, subjects answered questions assessing uncertainty appraisals (from ` Smith & Ellsworth, 1985): "How uncertain were you about what was happening in the story?" and, "How well could you predict what was going to happen in the situation?" As desired, participants who read the uncertain-sad story reported feeling more uncertain about what was happening, $t(32) = 2.78$, $p < .01$ and tended to be less able to predict what was going to happen, $t(32) = -1.86$, $p < .10$.

Participants. Two hundred and sixty four (mean age = 19.78 years, *SD* = 1.71; 131 females; 6 subjects missing gender data) participants completed Study 2, comprised of both University of Michigan undergraduates who participated to fulfill an introductory psychology course credit requirement, and participants from the local community who were compensated $10 for their time. Five subjects were removed from analysis: three who voluntarily self-reported that they did not feel emotions during the emotion induction in their post-task interview, and two who asked for the instructions to be repeated multiple times and did not appear to understand the instructions.

Procedure

Procedures for this study were very similar to Study 1, but were modified to capture the new focus on the level of uncertainty between the two sad stories. Participants empathized with the sad-uncertain (mean age = 19.76 years, *SD* = 1.64, *N* = 89, 44 females, 4 missing gender), sad-certain (mean age = 19.69, *SD* = 1.64, *N* = 85, 44 females), or neutral story (mean age = 19.93, *SD* = 1.88, *N* = 85, 42 females, 2 missing gender), between subjects. Before and after each story they filled out the self-reported emotion survey to which the term "uncertain" was added from the list in Study 1. After rating their post-story affect, all participants performed the ODT from Study 1 and reported WTP for each object. Ratings for how useful, how hedonic, and estimated cost were removed due to null effects in Study 1. Lastly, participants completed the four personality questionnaires from Study 1, as well as the intolerance for uncertainty scale (IUS; Sexton & Duglas, 2009) and the intolerance of ambiguity scale (IAS; Budner, 1962) to investigate whether trait-level responses to uncertainty exacerbate acquisition on the ODT. The IUS has 27 items that measure subjective discomfort with uncertainty and uncertain situations, including two factors: negativity (i.e., uncertainty has negative behavioral implications) and unfairness (i.e., uncertainty is unfair).

Results

Manipulation check. For the manipulation check, change in the single "uncertainty" item was tested in addition to the three composite scores for sadness, anxiety, and neutrality. Both sad groups felt more sad as a result of reading and empathizing with the uncertain-sad and certain-sad stories compared to the neutral story, omnibus: $F(6,744) = 30.44$, $p < .001$; post-hoc ps < .001. Additionally, both sad groups were more anxious, more uncertain, and less neutral than the neutral group, all $p < .001$. The certain-sad group also became marginally more sad than

the uncertain-sad group, post-hoc $p = .073$. Both the uncertain-sad and certain-sad groups had similar levels of anxiety and uncertainty, anxiety post-hoc: $p = .769$; uncertainty post-hoc: $p = .997$, which precludes us as using the *a priori* groupings for uncertainty. Since the manipulation checks failed to find differences between the uncertain-sad and certain-sad groups, we did not want to use the three groups as our independent variable to predict effects on acquisition. Instead, we based our analysis upon the emotion factors felt by each individual, regardless of their group assignment.

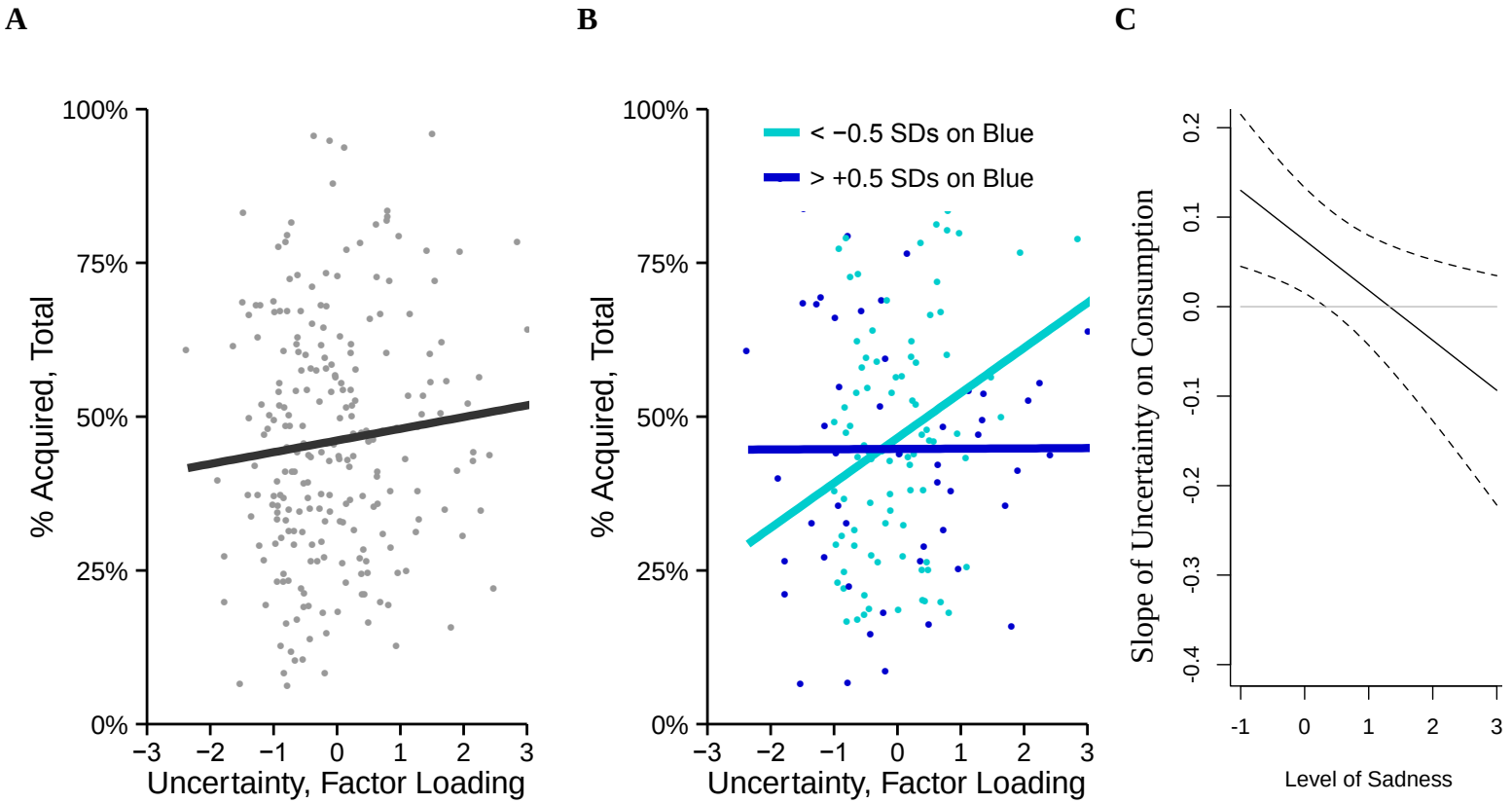
Patterns of emotions experienced. To separate patterns of emotions experienced, all self-reported emotion adjectives were entered into a factor analysis with a Varimax rotation. Five factors emerged, which accounted for 65.1% of the variance and had eigenvalues ranging from 5.34 to 1.85. The five factors (with their name and the emotion adjectives that loaded over 0.50 on that factor) were: (1) sad (empty, blue, unhappy, miserable, sad, depressed, troubled, upset, disappointed); (2) uncertain (nervous, anxious, tense, uncertain, worried, scared, afraid, jittery); (3) happy (joyful, pleased, happy, active, and strong); (4) neutral (unemotional, indifferent, and neutral); and (5) vigilant (alert and attentive). Factors one through five accounted for 19.08%, 17.80%, 11.85%, 9.70%, and 6.62% of the variance, respectively.

Patterns of emotion predict acquisition. To test the influence of emotions on acquisition, we created continuous emotion scores by averaging across the emotion adjectives with factor loadings higher than 0.50, listed above. As before, we evaluated acquisition using a repeated-measures ANOVA with item type (hedonic, functional, premium) and food/non-food factors as within-subject variables. Continuous emotion scores for uncertainty, sadness, and neutrality were used as the three between-subject predictors. Second-level interactions were modeled for anxiety and sadness because we expected uncertainty to vary within sadness, which

allowed us to assess whether subjects who felt sad and more or less uncertain show diverging effects on consumption. The vigilance composite score was not used to predict acquisition because it indexed an a more general arousal state rather than either of the more specific affective and appraisal dimensions that we were interested in.

Feeling more uncertain caused subjects to acquire more objects overall, $F(1,230) = 8.99$, $p = .003$, Figure 2.1A. The effect of uncertainty increasing acquisition was strongest in subjects who felt the least sad, as indicated by the interaction between uncertainty and sadness, $F(1,230) = 5.96$, $p = .015$. A moderation analysis showed that uncertainty significantly increased consumption at low levels of sadness, but the slope of uncertainty on consumption was not different from zero at high levels of sadness (slope differences are depicted at low and high levels of sadness in Figure 2.1B, and results of the moderation analysis are depicted in Figure 2.1C). No other main effects were significant on overall consumption, ps > .124. In line with previous research, feeling more sad increased acquisition of hedonic items but not functional or premium items, item type by sadness: $F(2,460) = 3.08$, $p = .047$; hedonic items: $\beta = 17.67$, $t(230) = 2.92$, $p = .004$; functional items: $\beta = 4.77$, $t(230) = 0.49$, $p = .494$; premium items: $\beta = 3.98$, $t(230) = 0.59$, $p = .558$.

Figure 2.1. Effects of emotion factors on acquisition in Study 2 (A, left and B, center), with points jittered to reduce overplotting. Scores on the Uncertainty factor are plotted on the x-axis, and the percent of items acquired overall are plotted on the y-axis. Slopes are colored by whether subjects' factor scores were lower than ½ a standard deviation below the mean or higher than ½ a standard deviation above the mean. (C) Graphical depiction of moderation analysis depicting the slope of uncertainty on acquisition on the y-axis, across levels of sadness (centered) on the x-axis. The solid line depicts the mean estimate of the slope, and dashed lines represent the 95% confidence interval.



Patterns of emotion predict WTP. Sadness increased WTP overall (as in Cryder et al., 2008), $F(1,230) = 6.22$, $p = .013$. Uncertainty marginally increased WTP, uncertainty main effect: $F(1,230) = 2.74$, $p = .099$. However, being both sad and uncertain led to decreased WTP, sadness by uncertainty interaction: $F(1,230) = 4.85$, $p = .029$. This interaction between sadness and uncertainty was significant across all item categories except for the least and most acquired item categories, an effect that is likely due to floor and ceiling effects, respectively, sadness by uncertainty by item type by food/non-food interaction: $F(2,460) = 2.83$, $p = .060$; effect in cells other than functional foods and premium non-foods, $\beta s < -0.28$, $ps < .025$.

Discussion

The results from Study 2 provide evidence that uncertainty increases the quantity of objects acquired, even when subjects are induced into an overall sadness-like state. Willingness to pay effects were similar, but showed a much stronger overall effect of sadness increasing WTP, in line with prior research (Cryder et al., 2008). Interestingly, there was an unexpected interaction between sadness and uncertainty. Across acquisition and WTP, subjects who felt low levels of sadness had increased acquisition rates and WTP, but subjects who felt higher levels of sadness did not show any increase in acquisition rates or WTP.

Rather than using a simple emotion approach, where each emotion is investigated in isolation from others, the current study allowed us to investigate how combinations of emotions are associated with consumption. More specifically, while we found a strong effect of uncertainty on the quantity of objects acquired, higher feelings of sadness led to the effect of uncertainty going away.

The exact reason for this is unclear, but could be due to opposing appraisals blunting one another or emotions combining to create a more unique state. An emotional blunting

interpretation (Winterich et al., 2010) suggests that emotions existing on opposing ends of an appraisal dimension can cancel each other out. For example, inducing people to feel sad, an emotion low in human agency, makes it more difficult to transition to anger, an emotion high in human agency, compared to transitioning from a neutral state. In the consumption domain, this would imply that uncertainty indeed does increase people's tendencies to acquire and consume more, but that when subjects also feel certain emotions it diminishes the influence of uncertain feelings on consumption. A stronger test of this hypothesis would be to use a manipulation to increase people's feelings of certainty, such as having them make estimates of easily predictable events, either before or after the uncertainty induction.

If the blunting account does not explain the data, it could be the case that high- and low-certainty sadness differ by more than just uncertainty. For example, recent work has investigated how mixtures of emotions influence physiological responses (Kreibig et al., 2013). In their study, they made participants feel disgust, amusement, or a mixture of disgust and amusement and compared their physiological response profiles. Appraisal theories would predict that there should be a continual shift in physiological profiles as participants' responses varied from disgust to amusement since they are simply moving along the appraisal dimensions separating disgust and amusement. However, they found that the physiological profiles of participants feeling mixed disgust-amusement was nothing like physiological profiles of disgust or amusement, which they termed an "emergent" physiological profile. If this occurs with other mixed emotion states, such as uncertain-sadness in Study 2, then it could be the case uncertain-sadness differs from certain-sadness by more than just uncertainty. To test this best it would be useful to find an emotion that is similar to sadness on many dimensions and can also be altered on its level of uncertainty, such as regret. Since certainty refers to the degree to which future

events seem predictable and comprehensible you can compare regretful situations that make it difficult to predict the future (e.g., regret quitting a disliked job because now you have an unpredictable income stream) and regretful situations where it is relatively easy to predict the future (e.g., regret leaving your job because you liked your co-workers, even though you like your new job and coworkers). If uncertain-regret leads to increased consumption, it suggests that the underlying dimension of uncertainty is associated with consumption, but if this effect is not found or decreases consumption then it suggests that emergent effects may account for the decreased consumption in uncertain-sadness.

General Discussion

The two studies reported here are the first emotion manipulation studies to our knowledge that investigated increases in acquisitiveness as opposed to shifts in preferences or WTP. We demonstrated that uncertainty leads to increased acquisition of items. In Study 1, we showed that uncertainty leads to more overall acquisition than sadness or a neutral affective state. In Study 2, we found that uncertainty within sadness led to similar increases in the quantity of items acquired, but only when the amount of sadness experienced was relatively low.

Effects of uncertainty and sadness on WTP were less consistent than the effect of uncertainty on consumption. In Study 1, there were indications that uncertainty led to higher WTP for functional objects and that sadness led to higher WTP for the best items (premium items), but these effects were within item types and not between groups. Study 2, however, showed a much more reliable and strong effect of sadness increasing WTP. This could be due to the technique used to separate emotional states in Study 2. In the second study, our analysis of emotions was based on a Varimax separation of emotions that more clearly separates sadness from uncertainty, and uses the continuous degree of each felt emotion. If the additional effects

coming out in Study 2 compared to Study 1 were due to this analysis strategy then we should find similar effects when using this strategy in Study 1. Indeed, using this strategy we find that uncertainty is associated with increased acquisitiveness, sadness is associated with increased WTP, and uncertain-sadness is associated with decreased WTP; however, the much smaller number of subjects do not allow these effects to surpass the traditional level of significance. This suggests that the effects produced by the more powerful analysis strategy in Study 2 were also apparent in Study 1, but that we did not have enough statistical power to detect them.

These studies add to the literature by focusing on acquisitiveness and how factors influencing acquisitiveness may not influence WTP. We found that uncertainty led to increased acquisitiveness, but that sadness led to increased WTP. Though we did not probe the underlying reason for this, prior research demonstrated that uncertain emotions lead to systematic processing and certain emotions lead to heuristic processing (Tiedens & Linton, 2001), suggesting that systematic processing is associated with increased acquisitiveness. Other work in our lab is in line with this. A prior study forced subjects to wait longer (5 seconds) before making their acquisition or forced them to make it immediately (within 1 second). Systematic processing would not have much influence over choices in the 1-second decision window, but should have a much stronger influence in the 5-second decision window. Indeed, subjects acquired more objects in the 5-second time window, corroborating the idea that systematic processing leads to increased acquisitiveness (Preston & Stansfield, unpublished data).

This work extends to sustainability issues, as our Westernized lifestyle has become much more uncertain, stressful, (Cohen & Janicki-Deverts, 2012) and materialistic in the past century (Twenge & Kasser, 2013). While these mechanisms of consumption may have originally evolved to adaptively secure access to valuable but unpredictable resources (Preston & Vickers, 2014;

Vickers & Preston, 2014), they may now be maladaptive in the current environment where stress and uncertainty are high, and items are plentiful and inexpensive. Messages promoting sustainability tend to use "doom and gloom," emphasizing our uncertain and fearful future, which these studies suggest may backfire and be detrimental to our ultimate goals. Instead, we may want to focus on certain emotions that promote engagement in more sustainable behaviors, such as pride and love, in order to accomplish longer-term goals for a cleaner, healthier world.

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Appendix 2A. Item Ratings.

Table 2.2. Mean ratings (SD) of items on hedonic and usefulness dimensions from Study 1.

Item Type		Item Description	Rating Type	
			Hedonic	Usefulness
Hedonic	NonFood	Silly Bandz	1.58 (1.64)	0.39 (0.82)
		Lava lamp nightlight	1.86 (1.78)	1.31 (1.51)
		Paper lanterns	2.57 (2.10)	2.09 (1.94)
		Poker chips	2.09 (1.80)	1.43 (1.52)
		Yo Yos	1.37 (1.51)	0.41 (0.82)
		Newton's Cradle	2.46 (1.93)	0.99 (1.39)
		Party poppers	1.80 (1.83)	0.70 (1.21)
		Snow globe	0.81 (1.30)	0.23 (0.48)
	Food	Candies, small hard, assorted	1.64 (1.79)	0.82 (1.10)
		Chocolate, Hershey's bar	3.02 (1.93)	1.60 (1.58)
		Ice cream sundae	3.61 (2.16)	1.71 (1.77)
		Kettle corn	2.98 (1.81)	1.80 (1.52)
		Truffles, Lindor	3.61 (1.98)	1.91 (1.60)
		Cookies, Oreos	3.44 (1.98)	2.00 (1.67)
		Wine, bottle	2.92 (2.20)	1.93 (1.87)
		Coke, 6 glass bottles	3.01 (2.04)	1.79 (1.56)
Functional	NonFood	Ziplock bags	1.59 (1.44)	4.10 (1.43)
		Hammer	1.20 (1.33)	3.93 (1.66)
		Paper towels, 6 pack	1.93 (1.74)	4.62 (1.60)
		Toilet paper, 6 pack	2.07 (1.75)	4.60 (1.67)
		Surge protector	2.21 (1.85)	4.86 (1.30)
		Scissors	1.38 (1.42)	4.14 (1.45)
		Stapler, black	1.56 (1.48)	4.00 (1.73)
		Umbrella, black	2.73 (1.77)	4.74 (1.23)
	Food	Chicken broth	0.80 (1.13)	1.96 (1.61)
		Flour	1.01 (1.20)	2.68 (1.95)
		Beans, black	0.83 (1.34)	1.59 (1.75)
		Tuna, 4 cans	1.17 (1.48)	1.68 (1.55)
		Rice, 5 lb bag	1.17 (1.38)	2.46 (1.85)
		Dehydrated food, 3 items	0.87 (1.22)	1.69 (1.53)

Item Type		Item Description	Rating Type	
			Hedonic	**Usefulness**
		Multivitamin	1.62 (1.76)	3.01 (2.01)
		Tomato paste	0.89 (1.21)	1.78 (1.60)
Premium	NonFood	G2 Pens	2.48 (1.64)	4.23 (1.33)
		Burts Bees Lip Balm	2.90 (2.03)	3.64 (1.81)
		Sharpies	2.68 (1.54)	3.26 (1.63)
		Sunglasses, aviators	3.93 (1.84)	3.51 (1.76)
		Bottle opener, silver	1.80 (1.67)	3.41 (1.57)
		Blanket, UM	4.10 (1.65)	4.22 (1.50)
		Flash drive	3.47 (1.83)	4.91 (1.41)
		Maglight	2.08 (1.61)	4.33 (1.51)
	Food	Bottled Water	2.11 (1.70)	3.61 (2.25)
		Trail mix, single pack	1.96 (1.72)	1.77 (1.66)
		Odwalla juice	2.98 (1.98)	2.42 (1.70)
		Ritz, box	2.58 (1.54)	2.03 (1.62)
		Peanut butter, jar	2.64 (1.79)	2.67 (1.91)
		Popcorn, salted	2.70 (1.85)	1.88 (1.68)
		Cashews, canister	2.02 (1.78)	1.78 (1.64)
		Salsa, 3 jars	2.30 (1.71)	2.13 (1.61)

Appendix 2B. Emotion Induction Stories from Study 2.

Sad-Certain Story

1. It is nearing the end of the spring semester and you need a break after a long term. The semester has been exhausting, and you could really use some time to relax with your family. It is the Sunday two weeks before finals and you have to work on a few assignments. You are in the shower, just letting the hot water spill over you when your roommate tells you that you have a phone call from your sibling. When you hear your sister (brother) you know that something is definitely wrong. She (he) tells you that your mom is very sick in the hospital, and that you need to come home. The doctors said that her condition is terminal, and you need to fly back immediately.

2. The flight home is draining. You are in a daze while you think about your mom and how her death will affect you. You feel badly about a recent argument that you had with your mom over the phone and wish you had had a chance to say that you were sorry before this happened. You know that it is too late now to make that apology because your sibling told you that the doctors did not have high hopes. Strangely, it seems as though people on the plane sense your distress and look and act sympathetically toward you.

3. Upon arrival, you take a cab to the hospital in the rain. Once there, you walk down the hallways and immediately find your mom's room. Upon entering, you see the rest of your family there. Their faces are pale and drained, their eyes are teary. They are huddled around your mom, who looks weakened and frail. Her skin is yellowed and she can barely move. You are overwhelmed by your feelings for your mom and how pained she looks.

4. You go to your mom's bed and kneel beside her, holding her hand. Her face rocks semi-consciously, flinching from time to time, and sometimes whimpering at the pain in her body. She looks up at you and the rest of the family, with a weak smile as she tries to reassure everyone, despite the circumstances. She raises her arms a little under the sheets as if to reach out to you and says "you're all here." "Of course we are," you reply. Then she says, "It's too bad that we all have to meet this way, isn't it?"

5. As you are watching her, she lays her head back down on the pillow and tells you that she feels like she is drifting off. She then closes her eyes and you see that her chest does not rise again. You realize she that has just taken her last breath.

Sad-Uncertain Story.

1. It is nearing the end of the spring semester and you need a break after a long term. The semester has been exhausting, and you could really use some time to relax with your family. It is the Sunday two weeks before finals and you have to work on a few assignments. You are in the shower, just letting the hot water spill over you when your roommate tells you that you have a phone call from someone. When you hear your sister (brother) you know that something might be wrong, but you aren't sure what it might be. She (he) says that your mom is very sick and in the hospital, but the doctors aren't sure what is wrong and you need to fly back immediately.

2. The flight home is confusing. You are in a daze while you try to understand what is happening. You think of many positive memories, but also really regret a recent argument that you had with your mom over the phone. Strangely, it seems as though people on the plane sense your distress and look and act sympathetically toward you. The captain gets on the intercom and says your landing time has been delayed due to a thunderstorm. They are not sure how long it will be and you feel badly because you know that the family is all waiting for you to arrive at the hospital.

3. Upon arrival, you take a cab to the hospital in the rain. Once there, you search the hallways until you find your mom's room. Upon entering, you see the rest of your family there. Their faces are pale and drained, their eyes are teary. They are huddled around your mom, who looks weakened and frail. Her skin is yellowed and she can barely move. You are overwhelmed by your feelings for your mom and how pained she looks.

4. You go to your mom's bed and kneel beside her, holding her hand. Her face rocks semi-consciously, flinching from time to time, and sometimes whimpering at the pain in her body. She looks up at you and the rest of the family, seeming to cry and smile at the same time. She raises her arms a little under the sheets as if to reach out to you and says, "You're all here. I wasn't sure you would make it." "We are," you reply. Then she says, somewhat hesitantly, "It is sort of strange being in this place, isn't it?"

5. Your mom is being treated by the best doctors, but they still don't know what is wrong with her. You all reassure your mom that she will be all right, but no one's voice sounds hopeful. You realize that this situation will not end soon.

Chapter 3: Why the Attic Overflows: Individual Differences and Psychopathology Predict Material Preferences

Abstract

Why do people amass goods to the point of financial, domestic, and environmental distress? Transient emotions influence product preferences and even sub-clinical psychopathologies like anxiety, depression, and obsessive compulsive disorder (OCD) can lead to overconsumption. To characterize which chronic affective states cause people to want particular goods—or an excessive amount—we surveyed controls, "packrats," and people with diagnosed general anxiety disorder (GAD), depression, social anxiety disorder, OCD, or panic/agoraphobia. Six item types were revealed that were differentially preferred across groups (in parentheses): Scrap Items (packrats, OCD, depression), Memorabilia (controls), Bomb Shelter Items (controls, OCD; disliked by panic/agoraphobia), Social & Domestic Goods (packrats, depression, panic/agoraphobia), Pets & Snacks, and Impulsively Purchased & Saved Items (packrats). Hoarding increased with depression (especially in GAD) and OCD, but each was associated with unique item preferences and hoarding symptoms. Thus, our qualitative, transdiagnostic approach was able to identify multiple, separable affective pathways to consumption.

Keywords: *acquisitiveness, hoarding, consumption, anxiety, depression, obsessive-compulsive disorder, comorbidity, transdiagnostic*

Introduction

Hoarding disorder is a challenging and relatively common psychological disorder in which individuals acquire and fail to discard so many items that their homes are unlivable, and cause significant impairment and distress to patients, their families, and the community. Clinical psychology and psychiatry have tried to better understand and treat hoarding by segregating those with and without comorbid obsessive compulsive disorder (OCD), arguing that most individuals with hoarding disorder do not have OCD, while OCD hoarders have a distinct presentation (Pertusa et al., 2008; Steketee & Frost, 2003; Tolin & Villavicencio, 2011). The general consensus is that hoarding is not necessarily or even primarily associated with OCD; as a result, hoarding disorder received its own diagnostic category in the 5th edition of the Diagnostic and Statistical Manual for Mental Disorders (DSM-5). Despite this, hoarding disorder is still highly comorbid with other disorders not only including OCD but also depression, anxiety, and social anxiety disorder among others, and we still do not understand its unique etiology (Pertusa et al., 2008).

Research to date has partially used individuals' distinct item preferences to segregate etiologies of hoarding, but more could be done in this regard. For example, an initial study distinguished hoarders with and without OCD, as only the former had magical and superstitious reasons for keeping items (Pertusa et al., 2010). But because research has focused on weakening the DSM link between hoarding and OCD, most prior studies only examined individuals with and without OCD. This has restricted the scope of disorders that have been investigated, decreasing the breadth of what we know about the relationship between affective disorders and preferences toward material goods. HD is diagnostically distinct from OCD but is comorbid with multiple disorders including OCD, depression, generalized anxiety disorder (GAD), and social

anxiety disorder (SAD) (Frost et al., 2011; Pertusa et al., 2008). Our own research, which investigates hoarding as an individual-differences construct, does find a correlation between the quantity of items taken and trait OCD-characteristics, but depression is also prominently correlated with hoarding in our samples (e.g., Preston et al., 2009). More research is needed to determine if people's preferences for particular items can be linked to distinct underlying psychopathological traits or states. The non-clinical literature has demonstrated that induced anxiety in typical populations increases preferences for useful objects, whereas induced sadness increases preferences for social objects (Raghunathan et al., 2006). However, they did not study individuals with chronic disorders or preferences for large quantities of items.

The goal of the current study was to provide a wide range of individuals—including those with and without hoarding tendencies and a variety of psychopathologies—with a comprehensive list of items that people often retain to reveal possible stable relationships between chronic affect and consumption. To develop a comprehensive list of goods, we started with *a priori* beliefs about different possible motivations for wanting to acquire and keep goods. For example, stuffed animal and doll collections may provide emotional comfort, stand in for social relationships, or remind people of their past while newspapers, canned goods, or scrap materials appear potentially useful, and stamps and coins are potentially valuable. On the basis of such *a priori* beliefs, the Relationship to Objects Scale (ROS) was created, including ratings about motivations for obtaining goods and a large number of objects commonly hoarded and retained.

The current study aimed to demonstrate different preferences for types and quantities of goods across a wide range of individuals with and without HD or psychopathology. The Relationship to Objects Scale (ROS) assessed preferences for items often kept beyond their

utility (e.g., useful, rewarding, sentimental, collectible), which was administered with a validated hoarding instrument to non-clinical controls, self-described and validated "packrats," and individuals with diagnosed GAD, SAD, panic/agoraphobia (P/A), Depressive Disorders (DD), and OCD. Anxiety disorders were expected to predispose individuals toward useful items and depression toward rewarding items, while hoarding symptoms were expected to increase with OCD and depression (Coles, Frost, Heimberg, & Steketee, 2003; Preston et al., 2009; Tolin, Meunier, Frost, & Steketee, 2011).

Methods

Participants

Controls and packrats. Controls and self-described "packrats" participated in a study about decision-making for controls or self-described "packrats" (respectively, n = 180). All participants completed the Hoarding Rating Scale (HRS); controls were screened to have scores less than 14 and packrats greater than 14 (Tolin, Frost, & Steketee, 2010). Participants also self-reported psychiatric diagnoses and completed trait measures of depression (the Beck Depression Inventory II, BDI-II; Beck et al., 1996), anxiety (the State Trait Anxiety Inventory-Trait Subscale, STAIT; Spielberger, Gorusch, Lushene, Vagg, & Jacobs, 1977), and OCD (the Obsessive-Compulsive Inventory, Revised, OCI-R; Foa et al., 2002). Controls had normal mean(SD) levels on the HRS (4.36(3.67)), BDI-II (5.90(5.87)), OCI-R (9.41(8.44)), and STAIT (38.19(10.33)). Packrats had high HRS scores (24.83(3.49) and elevated means and wider SD on the BDI-II (12.95(12.61)), OCI-R (18.37(14.95)), and STAIT (42.60(11.31)). Seven packrats self-reported psychopathology: three major depressive disorder (MDD), one ADD, one dysthymia, one MDD with GAD, and one combined MDD, GAD, OCD, and ADHD. None were excluded because comorbidities are typical in HD. Participants missing more than three ROS

items due to programming error (57 control, 16 packrat) or skipped items (5 controls, 2 packrats) were removed from analysis. Controls with self-reported clinical diagnoses (n = 8) or HRS > 14 (n = 8) were included for factor analysis only. Sixty-one controls (M(SD): age = 36.00(18.74); n = 50 females) and 23 packrats (age = 47.83(17.35); n = 22 females) remained for inferential comparisons.

Patients. A stress and anxiety clinic administered the ROS, HRS, Revised Behavior and Symptom Identification Scale (BASIS-R; Eisen, Normand, Belanger, Spiro, & Esch, 2004), Yale-Brown Obsessive Compulsive Scale (Y-BOCS; Goodman et al., 1989) and Sheehan Disability Scale (Leon, Olfson, Portera, Farber, & Sheehan, 1997) to 281 patients. Four additional participants with depression and six controls were also recruited for a sleep study and completed the ROS and HRS. After testing, seven patients were discarded for missing more than three ROS items due to programming error, twenty-four for skipping more than three items, and one for providing nonsensical data. One control with an HRS > 14 was included only for factor analysis. 257 patients and 1 control remained for inferential statistics. A subset of 128 patients were also given the Anxiety Sensitivity Index (Taylor, Zvolensky, Cox, Deacon, Heimberg, Ledley, ..., & Cardenas, 2007), Penn State Worry Questionnaire (Meyer, Miller, Metzger, & Borkovec, 1990), 13 questions on their current symptoms (e.g., worry/anxiety, sad/blue/depressed, irritability, etc.), 11 questions on life stresses (e.g., marital conflict, recent move, assault, legal problems, etc.), and a self-assessment of sleep problems.

Clinical patients had a variety of primary, secondary, and additional diagnoses but were collapsed into five coherent groups: GAD (n = 56, age M(SD) = 31.54(6.59), 36 females, 8 unknown), SAD (n = 21, age M(SD) = 26.20(4.66), 10 females, 3 unknown), P/A (n = 43, age M(SD) = 39.30(9.09), 26 females; 8 unknown), DD (n = 45, age M(SD) = 58.67(8.74); 21

females, 9 unknown; 42 MDD, 3 dysthymia), and OCD (*n* = 30, age M(SD) = 46.20(17.70); 17 females, 3 unknown). Patients with unrelated disorders were included for factor analysis but not group comparisons (*n* = 62; e.g., not otherwise specified (NOS), eating disorders).

The Relationship to Objects Scale

The Relationship to Objects Scale (ROS) is a novel questionnaire measuring subjective interest in household objects that are often retained in the home (Table S1). For each of 57 objects people indicate "The degree to which you like/have/collect each of the following items, whichever applies," on a Likert scale from 1 (Not at all) to 7 (Very much so). Liking, having, and collecting (hereafter operationalized as "preference") were combined to efficiently assess preferences while anchoring responses to possessions. The ROS also includes 12 statements that capture behaviors often associated with acquisitiveness, e.g., "I like to bring home items that I have found (on the curb, discarded by others)."

Analysis

Factor analysis on 359 individuals with Promax rotation identified ROS items that intercorrelate. The number of factors was determined using Parallel Analysis with a Monte-Carlo simulation, comparing our factor structure to a random data set with the same dimensions. Factor analysis cannot use missing data so data were imputed when participants skipped three or fewer items using the mean for that item for that group (control, packrat, clinical; 61 or 13% of participants; 0.3% of analyzed data; 5% case-wise).

Saved factor loadings per factor per participant were used to compare groups. Females were compared to males; controls, packrats and the five clinical groups were compared; and the five clinical groups were re-compared after integrating psychopathological packrats into their relevant clinical group (capturing the full expression of HD in psychopathology). Based on

threshold recommendations from the literature, seven packrats with BDI-II ≥ 13 were added to DD (Beck et al., 1996) and three with OCI-R ≥ 14 were added to OCD (Abramowitz & Deacon, 2006). All group comparisons used repeated-measures ANOVAs with the six factors as the repeated variable and group as the between-subjects variable. Post-hoc tests were corrected using Tukey tests; *t*-tests compared genders. The alpha threshold for significance was set at .05.

Results

Revealing Six Object Factors

We identified six item factors that accounted for 47.3% of the variance (Table S1-3): (1) Scrap Items—low-value items that are reused or repurposed like plastic bags or scraps of wood, paper or fabric; (2) Memorabilia—sentimental items like ticket stubs, awards, photos; (3) Bomb Shelter Items—durable items like toilet paper, canned food, bottled water, old bills; (4) Social & Domestic Goods—items with aesthetic/social value like art, platters, wine glasses, heirlooms; (5) Pets & Snacks—intrinsically rewarding items like pets, small mammals, candy, soda; and (6) Impulsively Purchased & Saved Items—hedonic items or impulse purchases like magazines, stuffed animals, purses and problems discarding and over-acquiring.

Qualitative Associations between Item Type and Group

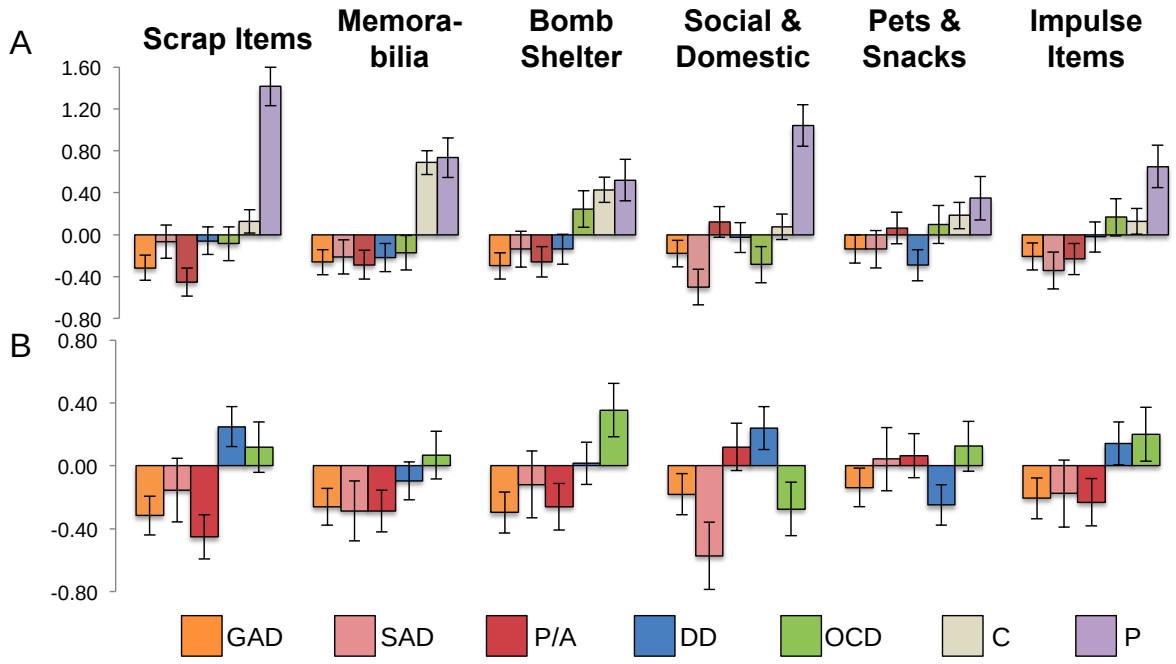
Gender. Females preferred all item types more than males, $F(1,322) = 16.17$, $\eta_p^2 = 0.05$, $p < .001$, especially Memorabilia, Social & Domestic Goods, and Impulsively Purchased & Saved Items, interaction: $F(5,1610) = 11.58$, $\eta_p^2 = 0.04$, $p < .001$, gender within types, ts(322) > 2.09, η_p^2s range = 0.01-0.12, ps < .038. Males did not prefer any types over females, ts(322) < 1.56.

Seven non-clinical and clinical groups. As expected, packrats preferred all object types over controls and the five clinical groups. Controls also preferred all types more than all clinical

groups except OCD (between packrats and the remaining clinical groups), main effect, $F(6,273) = 11.35$, $\eta_p^2 = 0.20$, $p < .001$; post-hoc packrats > all groups, ps < .01; controls > GAD, SAD, P/A, DD, ps < .028.

Looking at relative preferences within types across groups, controls and packrats preferred certain items but clinical groups did not prefer any types above packrats or controls, group x factor: $F(30,1365) = 3.06$, $\eta_p^2 = 0.06$, $p < .001$; group effect within factors: Fs(6,273) > 3.01, ps < .007, η_p^2 range = 0.06-0.22; Pets & Snacks, $p = .127$ (Figure 3.1). Items were least preferred by GAD, P/A and SAD; Controls preferred Scrap Items significantly more than P/A and GAD, Memorabilia more than all clinical groups, and Bomb Shelter Items over GAD, P/A, and DD. Packrats preferred Scrap Items more than all groups, Memorabilia more than clinical groups (being similar to controls), Bomb Shelter Items more than GAD and P/A (similar to controls, DD, and OCD), Social & Domestic Goods over all groups, and Impulsively Purchased & Saved Items over GAD and P/A. They were also marginally higher on Social/Domestic goods than SAD (similar to controls, DD, and OCD).

Figure 3.1. (A) Mean factor loadings across all seven groups. (B) mean factor loadings across the five clinical groups, including packrats with psychopathology (DD or OCD). GAD = Generalized anxiety disorder. SAD = Social anxiety disorder. P/A = Panic/agoraphobia. DD = Depressive disorder. OCD = Obsessive-compulsive disorder. C = Control. P = Packrat.



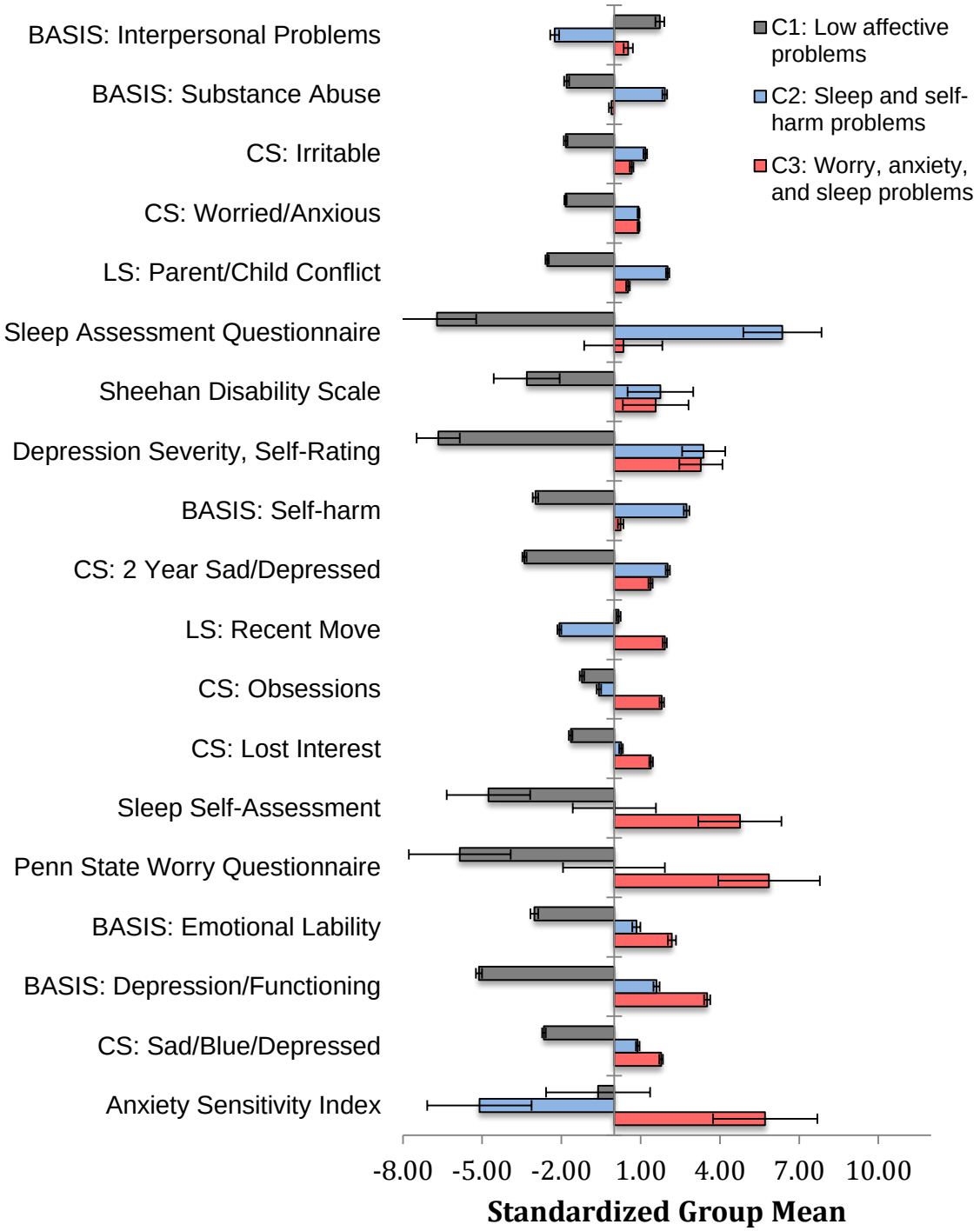
Five clinical groups including packrats. Excluding controls and nonpathological packrats (but including DD or OCD packrats in their relevant clinical group) enhanced differences across clinical groups, group by factor: $F(20,1000) = 2.60$, $\eta_p^2 = 0.05$, $p < .001$; effect of group within Scrap, Bomb Shelter, & Social and Domestic: Fs$(4,200) > 2.83$, ps $< .026$, η_p^2 range = 0.05-0.09; all other factors, ps $> .124$. Scrap Items were more preferred by DD than GAD and P/A, and marginally more by OCD than P/A. Bomb Shelter Items were more preferred by OCD than GAD and marginally over P/A. Social & Domestic Goods were significantly more preferred by DD and marginally more preferred by P/A over SAD. Thus, while patients had below-average interest in goods compared to controls and packrats, they still had relative preference differences. DD and OCD were more interested in most items than GAD, SAD, and P/A and both liked Scrap and Impulsively Purchased & Saved Items. However, only OCD

significantly preferred Memorabilia, Bomb Shelter Items, and Pets & Snacks while only DD preferred Social & Domestic Items and had mean preferences for Scraps over OCD—preferences more like those of packrats *per se*.

Transdiagnostic Approach: Qualitative Associations Across Clinical Diagnoses

In order to supplement the prior analysis with a transdiagnostic approach, we clustered patients based on all of the personality and symptom scales to give us different "types" of patients. These clusters were then compared on the ROS factor scores to investigate whether sub-classifications of patients have different acquisition tendencies.

Figure 3.2. Group differences on variables that went into the clustering solution for the patients. Variables significant at the $p < .05$ level are plotted on the y-axis, sorted by the group with the highest value. Clusters are separated by color. Error bars represent the average standard error of the mean. BASIS = Behavior and Symptom Identification Scale. CS = Current symptoms. LS = Life stress.



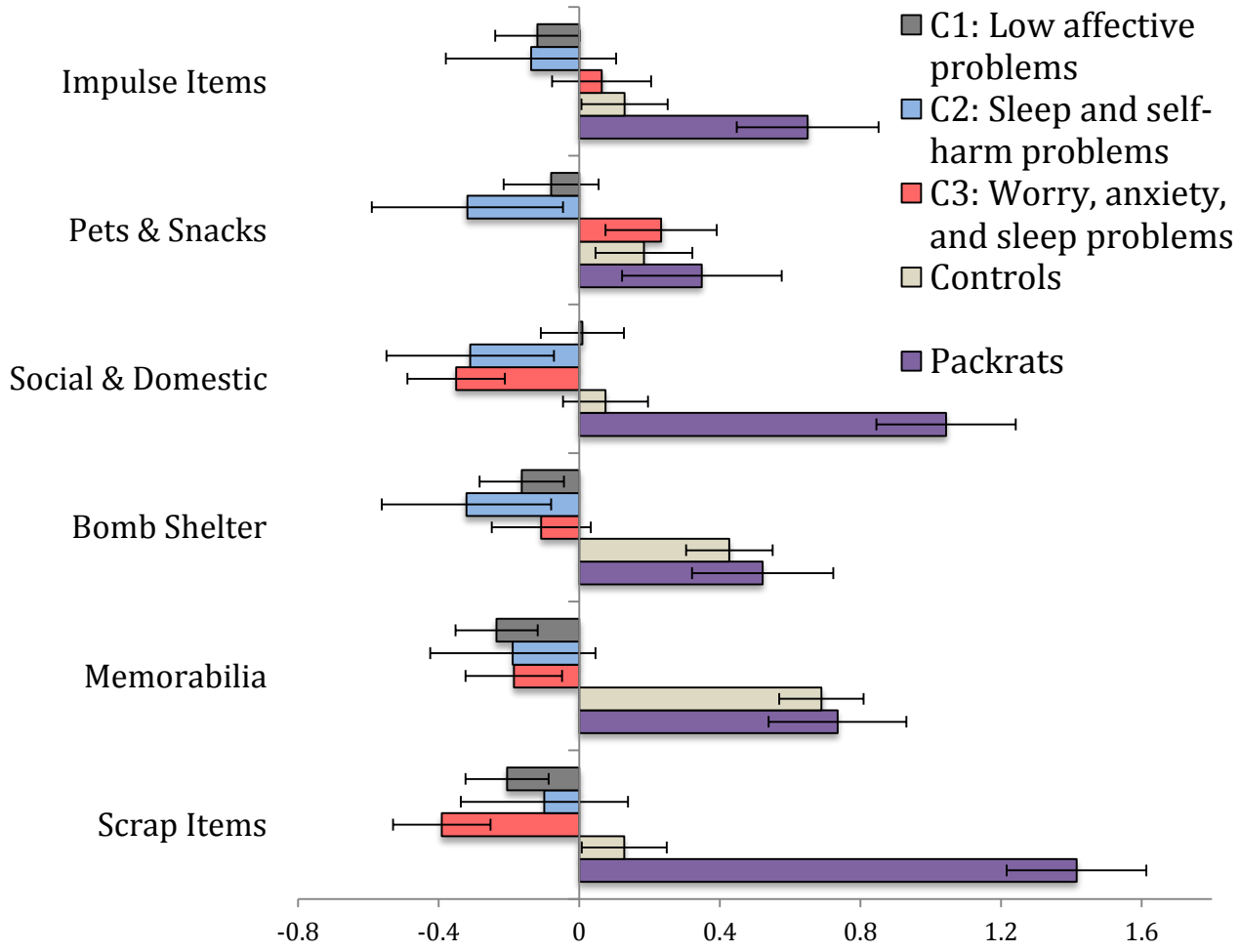
Clustering. All personality and symptom scales in the patients were used in a hierarchical clustering analysis with Ward's method. Upon reviewing the clustering solutions, three clusters split subjects well while retaining a sufficient number of subjects per cluster for group-level comparisons on the ROS factors. Based on comparisons between groups at the $p < .05$ level, the first cluster (C1; $n = 65$) had few affective problems generally but some interpersonal stress. The second cluster (C2; $n = 16$) had sleep and self-harm problems. The third and last cluster (C3; $n = 47$) had a high degree of worry, anxiety, and sleep problems. Significant group comparisons based on the clustering variables are plotted in Figure 3.2, with all data standardized for easier comparisons.

Clustering differences in acquisition patterns. The three-cluster solution was then re-coded for comparisons with controls and packrats on each of the ROS factors. Collapsing across all factors, there was a main effect of group due to packrats being significantly higher than all groups, ps < .01, and controls being higher than the clinical clusters, ps < .05, omnibus main effect, $F(4,208) = 12.81$, $p < .001$, $\eta_p^2 = 0.20$. There was also a group by factor interaction, $F(20,1040) = 3.67$, $p < .001$, $\eta_p^2 = 0.067$.

Groups differed on all factor scores except for Pets & Snacks, Fs(4,208) > 2.90, ps < .030, η_p^2 s > 0.050; Pets & Snacks $F(4,208) = 1.61$, $p = .173$. Packrats were higher than all groups on Scrap Items and Social & Domestic factors, ps < .030. Packrats were also higher than all of the patient clusters on Memorabilia, but did not differ from Controls. Finally, Packrats were more interested in Bomb Shelter and Impulsive Spending & Saving factors than the low affective problems cluster (C1), ps < .040. Controls were higher than all clinical groups on Memorabilia and Bomb Shelter items, ps < .05, and higher than the worry and anxious cluster

(C3) on Scrap Items, p = .042. None of the patient groups differed from one another on the ROS factors. All differences are shown in Figure 3.3.

Figure 3.3. Group differences in ROS factor scores between clustered patient groups, controls, and packrats. ROS factors are listed along the y-axis, mean factor scores and standard errors of the mean along the x-axis, and groups are separated by color.



Discussion

Shining a light on qualitative and quantitative material preferences clarified multiple aspects of consumer psychology and psychopathology. We focused on items that even typical people keep, which contribute to clutter even when they are infrequently used (i.e., excluding uncontested items like televisions or mattresses), we found six stable item types: scrap items,

memorabilia, durable/utilitarian items, social and domestic goods, pets and snacks, and trouble with impulsive purchases and discard decisions. Most of these categories were expected, apart from the fact that pets and snacks formed a single factor. Likely, pets and snacks are both underserved by dopaminergic reward processes like drugs of abuse, chocolate, and food-storing (S. D. Preston, 2013)—suggesting that this system should be investigated in people who hoard animals.

Females were more interested in goods than males, particularly memorabilia, social and domestic goods, and impulsively purchased and saved items. The ROS may have been biased toward females, but females also suffer more from comorbid anxiety and depression (Cummings, Caporino, & Kendall, 2013) and have higher hoarding symptoms in our sample on the HRS, which is not gender biased. However, further research must examine gender differences since laboratory research often shows a female selection bias despite finding higher male prevalence in epidemiological studies (Samuels et al., 2008), and we found higher HD symptoms in OCD women as opposed to a prior study (Tolin et al., 2011).

Packrats were defined by their greater preference for all goods, but still exhibited informative relative preferences. Both packrats and controls preferred goods in general more than clinical groups, confirming that mental illness alone cannot create hoarding problems. Packrats' problems with scrap items and acquiring or keeping items impulsively is already well documented (Frost & Gross, 1993; Frost, Steketee, & Williams, 2002; Grisham, Brown, Savage, Steketee, & Barlow, 2007). However, the fact that they preferred social and domestic goods more than controls, and bomb shelter items less than controls suggests that their motivation is not homologous to the drive to save survival-related items as in food-storing rodents, but rather the drive to use goods as a social display as in bowerbirds (S. D. Preston, 2013). Their interest in

social/domestic items also suggests a strong social motivation, despite or possibly due to having marked interpersonal problems (Frost, Steketee, Williams, & Warren, 2000; Tolin, Frost, Steketee, & Fitch, 2008).

Unique Clinical Preferences

Patients were less interested in goods but did have informative relative preferences. The only P/A preference was to prefer social and domestic goods more than social anxiety patients, perhaps because the home provides a safe space for this population. GAD's general disinterest in goods was surprising since the disorder is often comorbid with HD (Frost et al., 2011) and GAD exacerbated hoarding with depression in our sample. GAD's specific problem over-acquiring may be harder to reveal with a survey measure that lacks incentive salience, or GAD may only produce hoarding problems with comorbid depression.

Depression and OCD were both more interested in goods than other patients and equally preferred scrap and impulse items—similarities that explain why it has been hard to disentangle the relevance of both disorders to HD. However, only OCD preferred memorabilia, bomb shelter items, and pets and snacks above average, while only DD preferred social and domestic items (and to some extent scraps). Thus, otherwise-similar looking problems with goods can be disentangled through a more substantive analysis of the types of items preferred.

Transdiagnostic Approach to Across Clinical Disorders

Using our clustering approach we were able to ignore the disorders that subjects were diagnosed with and investigate how their overall symptomology influenced qualitative patterns in object acquisition. We found three distinct groups of patients: One with very few symptoms and little life impairment, one primarily with sleep and self-harm problems, and a third that had worry, anxiety and sleep problems along with higher levels of impairment more generally.

Again we found that Packrats tended to have the largest interest in most goods, but this was mainly due to Packrats being higher than the least impaired patients (C1). Additionally, the anxious and depressed patient cluster (C3) was uniquely *dis*interested in acquiring Scrap Items compared to controls, suggesting that the combination of anxiety and depression may decrease the desire to acquire things that they do not have an immediate use for. This is interesting because both anxiety and depression are highly comorbid with hoarding disorder, yet their object preferences were *opposite* on the Scrap Items factor that most-differentiated the Packrats from the other groups. This pattern of anxiety and depression leading to decreased acquisition has been found before (Preston & Vickers, 2014), but leaves open questions regarding differences in the unique contributions of anxiety, sadness/depression, and anxious-sadness/depression combined. While this data across studies is consistent with one another, future research should examine and replicate this finding with alternate paradigms and other participant pools.

A Social View of Hoarding

Research on hoarding and consumer psychology supports our nascent emphasis on social drives in packrats and depressed individuals. For example, HD is often associated with greater attachments to goods (Frost & Gross, 1993; Grisham et al., 2009; Steketee et al., 2003). Hoarding is also associated with trait empathy, and depression with GAD (our most severe comorbidity) uniquely predict empathic fantasy (Fontenelle et al., 2009). HD is also associated with higher rates of SAD (Coles et al., 2003) and individuals with SAD report keeping items to improve their social appearance (Vigne, de Menezes, Yücel, & Fontenelle, 2013), just as typical people rely more on goods after feeling rejected (Mead, Baumeister, Stillman, Rawn, & Vohs, 2011).

Goods are often regarded in consumer psychology as symbolic forms of social identity, bi-directionally helping consumers determine and refine their self-concept while communicating that identity to others (Belk, 1988; Solomon, 1983). Research even specifically suggests that the interest by packrats and depressed patients in aesthetic items reflects a need for self-affirmation (Townsend & Sood, 2012), making self-affirmation a potentially useful future intervention. Further research needs to determine the degree to which individuals rely on social and aesthetic goods to communicate their worth to themselves or others, to soothe themselves, or simply to enhance the home environment in populations who do spend disproportionate amounts of time at home.

Conclusion

Despite the fact that people spend significant time, energy, and money acquiring material goods and maintaining order over their possessions, they rarely consider why they have so many things that they rarely use. Clinicians also fail to deeply examine people's possessions as indications of their underlying issues, making it difficult to understand HD (but see Pertusa et al., 2008). Virtually no one considers how affective states that are so common in the general population—like depression and anxiety—potentiate our already strained relationship with goods (but see Preston & Vickers, 2014). Through a detailed investigation, we found distinct material preferences within and across multiple psychopathologies associated with different underlying motivations. Our results suggest that depression plays a strong role in increased acquisition, but that depression may with high comorbid anxiety may have decreased acquisition problems. Our trans-diagnostic, qualitative approach is in keeping with the directives of the National Institutes of Health and can be applied broadly to ameliorate the effects of chronic affect on well-being and the environment.

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Appendix 3A. Relationship to Objects Scale.

Table 3.1. Factor loadings for 5-factor relationship to objects scale solution. Motivational items are identified with quotations.

	Item	Factor 1: Scrap Items	Factor 2: Memorabilia	Factor 3: Bomb Shelter	Factor 4: Social / Domestic	Factor 5: Pets & Snacks	Factor 6: Impulsive Buying & Saving
1.	Repair	0.75	0.38	0.35	0.47	0.28	0.23
2.	"I like to bring home items that I have found (on the curb, discarded by others) because I can fix them up and/or find a use for them."	0.68	0.20	0.17	0.28	0.20	0.28
3.	Newspaper	0.68	0.36	0.32	0.22	0.24	0.14
4.	Flyers	0.68	0.50	0.44	0.25	0.25	0.22
5.	Packing	0.64	0.36	0.40	0.55	0.19	0.16
6.	Wood scraps	0.62	0.23	0.25	0.42	0.19	0.03
7.	Paper scraps	0.59	0.43	0.41	0.33	0.23	0.32
8.	"I tend to keep information from newspapers, magazines, bills, or mailings because I may need them or can use them later."	0.58	0.34	0.32	0.23	-0.07	0.41
9.	Bags	0.57	0.42	0.53	0.25	0.17	0.25
10.	"I buy or keep things because I know that one day they will be valuable and I can sell them for a profit."	0.56	0.33	0.33	0.28	0.11	0.31
11.	"I have trouble with clutter in my office or home, with multiple piles of stuff and difficulty finding things when I need them."	0.55	0.34	0.19	0.25	0.19	0.39
12.	Coins	0.52	0.50	0.32	0.23	0.37	0.15

	Item	Factor 1: Scrap Items	Factor 2: Memorabilia	Factor 3: Bomb Shelter	Factor 4: Social / Domestic	Factor 5: Pets & Snacks	Factor 6: Impulsive Buying & Saving
13.	Stamps	0.50	0.46	0.27	0.34	0.32	0.10
14.	Awards	0.27	0.75	0.41	0.29	0.13	0.23
15.	Memorabilia	0.28	0.70	0.35	0.43	0.14	0.38
16.	Tickets	0.40	0.66	0.25	0.14	0.19	0.25
17.	Photos	0.24	0.65	0.50	0.53	0.15	0.45
18.	Pens	0.55	0.62	0.49	0.30	0.29	0.41
19.	CDs	0.19	0.61	0.48	0.26	0.30	0.25
20.	Keychains	0.53	0.60	0.44	0.19	0.42	0.36
21.	Pencils	0.56	0.58	0.48	0.23	0.32	0.29
22.	Electronics	0.25	0.58	0.49	0.20	0.18	0.13
23.	Artwork	0.34	0.56	0.20	0.40	0.17	0.25
24.	"I have trouble getting rid of things from my past, like old letters, school assignments, artwork and such."	0.53	0.55	0.19	0.21	0.05	0.48
25.	School assignments	0.38	0.55	0.10	0.07	0.03	0.21
26.	Books	0.33	0.53	0.36	0.38	0.15	0.44
27.	Toilet paper	0.27	0.30	0.74	0.36	0.36	0.21
28.	Canned food	0.41	0.30	0.72	0.39	0.39	0.20
29.	Snacks	0.21	0.48	0.67	0.22	0.54	0.44
30.	Water	0.18	0.33	0.66	0.11	0.39	0.26
31.	Financial records	0.31	0.43	0.64	0.35	-0.11	0.11
32.	Paper plates	0.31	0.19	0.64	0.48	0.17	0.26
33.	T-shirts	0.28	0.63	0.63	0.08	0.33	0.32
34.	Bills	0.35	0.39	0.60	0.30	-0.10	0.15

	Item	Factor 1: Scrap Items	Factor 2: Memorabilia	Factor 3: Bomb Shelter	Factor 4: Social / Domestic	Factor 5: Pets & Snacks	Factor 6: Impulsive Buying & Saving
35.	Shoes	0.14	0.51	0.58	0.40	0.33	0.47
36.	Coupons	0.45	0.40	0.56	0.38	0.26	0.36
37.	Soda	0.03	0.13	0.54	0.04	0.51	0.31
38.	Mugs	0.49	0.35	0.53	0.37	0.32	0.35
39.	Tools	0.43	0.31	0.49	0.43	0.14	-0.07
40.	Hats	0.25	0.38	0.44	0.24	0.23	0.24
41.	Gift wrap	0.42	0.47	0.52	0.70	0.19	0.37
42.	Framed art	0.33	0.30	0.32	0.70	0.26	0.31
43.	Platters	0.38	0.26	0.56	0.69	0.16	0.18
44.	Used furniture	0.62	0.28	0.37	0.66	0.26	0.20
45.	Furniture	0.41	0.20	0.17	0.64	0.24	0.16
46.	Fabric	0.59	0.27	0.30	0.60	0.20	0.25
47.	Heirlooms	0.30	0.55	0.32	0.60	0.05	0.31
48.	Wine glasses	0.30	0.37	0.39	0.59	0.30	0.25
49.	Retro	0.49	0.38	0.33	0.57	0.34	0.31
50.	“I keep a supply of things that will be handy when people come over (e.g. serving plates, candles, games, or particular music).”	0.12	0.34	0.39	0.49	-0.05	0.39
51.	Money/savings	0.24	0.38	0.38	0.39	0.13	0.02
52.	Pets	0.15	0.25	0.36	0.40	0.72	0.37
53.	Dogs	0.09	0.27	0.32	0.35	0.71	0.30
54.	Small mammals	0.35	0.25	0.23	0.12	0.69	0.12
55.	Cats	0.23	0.21	0.24	0.28	0.63	0.20
56.	Fish	0.27	0.23	0.34	0.02	0.61	0.12

	Item	Factor 1: Scrap Items	Factor 2: Memorabilia	Factor 3: Bomb Shelter	Factor 4: Social / Domestic	Factor 5: Pets & Snacks	Factor 6: Impulsive Buying & Saving
57.	Birds	0.24	0.14	0.24	0.13	0.57	0.14
58.	Can y	0.26	0.42	0.48	0.09	0.53	0.31
59.	“I often take in animals that are stray or that other people say they can no longer take care of.”	0.31	0.10	0.09	0.26	0.47	0.38
60.	“I try to display things in my home or garden that represent who I am and what I am like.”	0.07	0.23	0.18	0.41	0.06	0.63
61.	“I will always keep something that was given to me, especially if it was a gift from someone that I like, even if I don't particularly need the item.”	0.33	0.46	0.29	0.15	0.17	0.57
62.	“Friends or family have complained about how much or how often I buy things (at stores, online, through catalogs, or in response to television ads or home shopping).”	0.28	0.30	0.26	0.07	0.35	0.55
63.	Purses	0.28	0.59	0.45	0.39	0.28	0.53
64.	Stuffed animals	0.20	0.53	0.21	0.19	0.28	0.51
65.	Candles	0.27	0.32	0.55	0.45	0.36	0.51
66.	Magazines	0.46	0.34	0.46	0.32	0.30	0.49
67.	“I have special places where I keep certain food items.”	0.22	0.17	0.39	0.14	0.23	0.47
68.	“I have one or more collections of things that I actively add to or maintain.”	0.38	0.29	0.16	0.20	0.19	0.46
69.	Dolls	0.24	0.23	0.19	0.21	0.13	0.26

Table 3.2. Correlation matrix of 5-factor relationship to objects solution.

	Factor				
Factor Number: Name	**2**	**3**	**4**	**5**	**6**
1: Scrap Items	0.44	0.36	0.34	0.24	0.22
2: Memorabilia		0.5	0.31	0.25	0.4
3: Bomb Shelter Items			0.38	0.33	0.33
4: Social & Domestic Goods				0.15	0.27
5: Pets & Snacks					0.28
6: Impulsively Purchased & Saved Items					

Table 3.3. Factors of the relationship to objects scale and Tukey corrected post-hoc tests from analyses across the seven groups and five clinical groups. Eigenvalues, percent of variance explained by each factor, and top five items on each factor. Motivational items included as partial sentences.

Factor	Eigenvalue,	% Variance	Factor Name	Top Items	Results Across All 7 Groups	Results Across 5 Clinical Groups
1	19.26	27.91%	Scrap Items	Fixing up found items; newspaper; flyers; packing supplies	Packrats > All groups*** Controls > P/A*, GAD^{t}	DD > P/A***, GAD* OCD > P/A^{t}
2	23.59	5.20%	Memorabilia	Awards; memorabilia; old tickets; photos; pens	Controls > All groups, but Packrats*** Packrats > All, but controls**	*ns* post-hocs
3	3.05	4.42%	Bomb Shelter Items	Toilet paper; canned foods; snacks; water; financial records	Controls > GAD**, P/A**, DD* Packrats > GAD*, P/A*	OCD > GAD*, P/A^{t}
4	2.72	3.94%	Social & Domestic Goods	Gift wrap; framed art; platters; used furniture, furniture	Packrats > GAD***, DD***, SAD***, OCD***, Controls***, P/A**	DD > SAD* P/A > SAD^{t}
5	2.27	3.29%	Pets & Snacks	Pets; dogs; small mammals; cats; fish		*ns* post-hocs
6	1.78	2.58%	Impulsively Purchased & Saved Items	Displaying identity buying; purses; stuffed animals	Packrats > GAD**, P/A**, SAD^{t}	*ns* post-hocs

Note: GAD = Generalized Anxiety Disorder. SAD = Social Anxiety Disorder. P/A = Panic/Agoraphobia. DD = Depressive Disorder. OCD = Obsessive-Compulsive Disorder.
*** $p < .001$. ** $p < .01$. * $p < .05$. ^{t} $p < .10$.

Chapter 4: Maternal and Charitable Caregiving in the Brain: Motor-Motivational Influences on Decisions to Donate to Charities

Abstract

The majority of research in the field of altruism and empathy focuses on small acts of aid or warm, empathic consolation of people in negative circumstances. These types of models do not subsume the many acts of heroic aid, such as people putting themselves in bodily danger by jumping into freezing rivers to save unrelated individuals. The Offspring Caregiving Model (OCM) of altruism (Preston, 2013) distinguishes these more immediate, heroic actions that involve motor-motivational systems and longer-term, nurturant help behaviors that involve sympathy. The OCM suggests that bringing online processes associated with activation/arousal will make people more likely to help. To test this model, we created descriptions of charities that were nurturant or heroic, and varied in the extent that they made participants feel activation/arousal. Participants viewed charities, earned money, and made decisions to donate money to each charity while their brain activation was measured. While *a priori* classifications of the charities did not produce differences in donations, continuous measures along dimensions of interest showed that participants donated more to charities that were more nurturant (vs. heroic), and nurturant charities that were higher in activation/arousal (vs. lower in activation/arousal) received higher donations. Additionally, these nurturant-active charities led to the most robust brain activation in areas previously associated with warm feelings toward others and increased donations.

Introduction

Extensive behavioral evidence suggests that people can and do act altruistically, helping others at a cost to the self (Stephane D Preston, 2013). However, many real-world acts of altruism, such as jumping into an icy river to save a baby, involve putting oneself into dangerous circumstances. Other acts of altruism, such as soothing and comforting a friend after the loss of a close family member, involve less danger. The present study aimed to investigate how types of helping actions lead to differential support, as well as the underlying neural activity associated with these behaviors.

Prior work in empathy and altruism has been focused on feelings about another person in need of help. Feeling similar either in the form of affective resonance or emotional contagion (i.e., feeling similar or feeling "with" the target) or overlap in mental and neural representations (Preston & de Waal, 2002) leads to increased helping. Sympathy and empathic concern involve warm, caring feelings for others that typically lead to an increased desire to help and helping behaviors. On the other hand, personal distress involves feeling troubled, upset, and worried and these feelings lead to disengagement and less helping (Batson, Fultz, & Schoenrade, 1987; Preston & Hofelich, 2012). However, this work has typically focused on prototypical others where their distress is abundant, others that do not encompass the heroic acts documented in newspaper stories.

The Offspring Caregiving Model of Altruism (OCA) (Preston, 2013) has extended prior work to multiple aspects of the target in need and the helping act. At the target-level, when the target is vulnerable, unable to help itself, or close to you (e.g., family members or close friends) helping is increased. Perceptions of the target being distressed or in need (the target's state-level) also lead to increased helping from others. Finally, at the response-level, helping behaviors are

increased when the observer can bring to mind a clear, effective plan that they are able to implement without fear of harm to the self. A number of studies have investigated factors at the target- and state-level, but much less has been done at the response-level, which is the focus of the current study.

The OCA distinguishes two types of helping behaviors (Preston, 2013). Heroic behaviors involve putting the self at bodily risk to help another, such as jumping into icy waters to save a drowning child. In contrast, nurturant behaviors involve comforting and soothing others that are distressed by their current circumstances, such as comporting people who have lost someone close to them or apes soothing others who have lost a fight and status. Both types of behaviors can lead to helping via the mesolimbic reward system that includes structures such as the ventral tegmental area (VTA) and nucleus accumbens (NAcc), but the two may be hindered by different factors. Heroic behaviors are very dangerous and helpers may disengage from helping if they perceive that the situation is too risky or if they do not have the expertise to deal with the circumstances (e.g., untrained onlookers being more reluctant to rush into a burning building to save another person). Nurturant behaviors are less dangerous but can result in disengagement if the other displays extreme distress that the helper does not want to or cannot cope with (Batson et al., 1987; Hauser, Preston, & Stansfield, 2014). These heroic and nurturant responses were the first factor investigated in the current study.

The second factor that we investigated was whether the activation of motor-motivational representations would increase helping behaviors. Seeing another in distress automatically activates cognitive and neural representations associated with the other's distress (Preston & de Waal, 2002), including representations of helping actions. The OCA proposes that if the perception of another's distress leads helpers to bring online motor representations associated

with acting then they are more likely to help. Prior work in our lab found support for the idea that more active associations lead to more help than passive, preparatory associations. When subjects processed more active forms of helping they donated more to charities compared to processing more passive, preparatory helping (Vickers & Preston, in prep). The limitation of this study was in its behavioral nature, meaning that it was unable to inform our hypotheses regarding the activation of neural representations.

The aim of the current study was to replicate our work in charitable donations and test the underlying neural hypotheses proposed by the OCA. In the present study, participants earned real money and made donation decisions while undergoing functional magnetic resonance imaging (fMRI) to measure brain activation. Participants viewed descriptions of charities that used framing to vary the desired dimensions (nurturant vs. heroic; passive and preparatory vs. active). For example, the four framings for capsized boaters were, "jumping in to retrieve people whose boats capsized in a storm with special harnesses" (heroic-active), "administering warming treatments to boaters rescued from capsized boats during storms" (nurturant-active), "making special harnesses to safely rescue boaters from capsized boats during storms" (heroic-passive), and "purchasing warming blankets to treat boaters rescued from capsized boats during storms" (nurturant-passive). Participants viewed these charities and made donation decisions, with subsequent analyses looking at differences in donations and neural activation.

In line with prior behavioral work (Vickers & Preston, in prep) we hypothesized that nurturant and heroic frames would lead to differential activation of the underlying neural circuitry. Building upon evidence that feelings of activation and arousal lead to greater helping, we hypothesized that there would be a main effect of greater donations to active than passive charities.

Fewer studies have looked at differences in neural activation while subjects made charitable donations, but implicate the reward system in increased donations. Moll et al. (2006) found that subjects activated similar areas when making donations to charities and receiving money, suggesting a strong overlap in processing, and that decisions to donate at a cost to the self activated the anterior pre-frontal cortex (PFC). Another study investigated the neural underpinnings of the identifiable victim effect, whereby identifiable victims receive higher donations than anonymous victims (Genevsky, Västfjäll, Slovic, & Knutson, 2013). They found that helping identifiable victims activated brain regions associated with facial processing (bilateral fusiform cortices), but only activation in the NAcc was associated with increased donations to identifiable compared to anonymous victims.

The MCMA proposes parallel neural processing associated with approach and reward compared to avoidance and fear. Since nurturant and active charities are associated with increased donations, we hypothesized that they would activate the reward-route (e.g., VTA, NAcc) compared to heroic and passive charities. Multiple forms of motor priming led to higher donations, which we hypothesized is mediated by the activation of motor representations. Since complex motor representations are stored in the premotor area, we hypothesized that active charities would activate the premotor area more than passive charities, and that activation of the premotor area would be associated with increased donations.

Methods

Participants

Thirty-one (31; N = 15 females) people from the local Ann Arbor, Michigan community participated and were compensated $40 for their time plus token bonuses, explained below. Participants were screened via phone for MRI contraindications, to ensure that they were

between 18 and 30 years of age, right handed, and had no history of neurological or psychiatric illness. Two subjects were removed, one due to a power outage at the fMRI center and one due to excessive head movement (larger than ± 3 mm), leaving 29 subjects for analysis (mean age = 21.62 years, *SD* = 2.68). All procedures were approved by the University of Michigan Medical Institutional Review Board.

Procedure

Upon entry to the University of Michigan Functional MRI Lab, subjects were consented and provided an overview of the study. In the Charity Donation task, subjects saw descriptions of an activity performed by a charity and were given the opportunity to donate to that charity. Afterward, they performed three shorter "localizer" tasks. The goal of the first and second localizers was to isolate activity associated with more complex motor procedures (e.g., pre-motor and supplementary motor areas) but not also activated during primary motor procedures (e.g., primary motor cortex). The third localizer aimed to isolate areas associated with warm, nurturant feelings toward a vulnerable other.

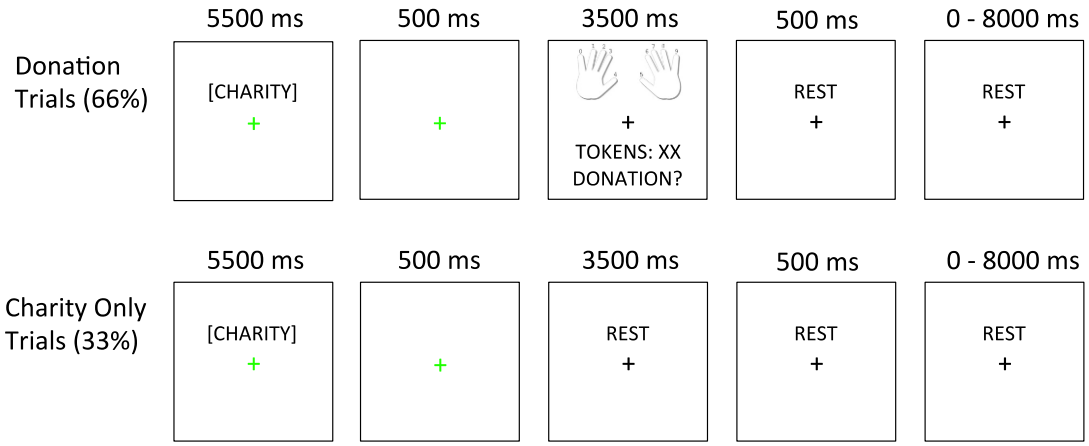
In the first localizer, the Motor Tapping task, participants tapped their left and right index fingers in blocks. In the second localizer, the Motor Retrieval task, participants viewed pictures of objects and either imagined reaching out and grabbing them or watched them on the screen. In the third localizer, the Nurturance task, participants passively viewed images of adults and babies on the screen.

Before going into the fMRI scanner, subjects performed 6 trials of the main donation task and two blocks of each localizer on a computer outside the scanner for practice. Subjects were then situated in the scanner with five-button custom response claws on their left and right hands, allowing 10 possible responses. We then acquired a high resolution T1-weighted scan for

normalization purposes, four runs of the main charitable donation task, and one run each of the Motor Tapping localizer, Motor Retrieval localizer, Nurturance localizer, and a high resolution SPGR anatomical scan. Total scan duration was approximately 45 minutes. Outside the scanner, participants subsequently made ratings of the charities and then filled out personality questionnaires. The total study took about 2 hours.

Charitable donation task. The charitable donation task consisted of intermixed Charity only or Charity plus Donation trials (see Figure 4.1). After the suggestions of prior work (Ollinger, Corbetta, & Shulman, 2001; Ollinger, Shulman, & Corbetta, 2001), 2/3 of trials included donation responses while the other 1/3 of trials were "catch" trials that had the charity description only. This design was employed to dissociate BOLD activity in response to charity evaluation versus donation decision while keeping the total trial duration constant. Each of the four runs consisted of 24 trials (16 charity and donation, 8 charity only) split evenly among our four trial types, for a total of 96 trials for analysis. Trial types were pseudorandomized to allow equal numbers of trial types to follow one another. Inter-trial intervals (ITIs) were jittered between 0 and 8000 msec (mean = 1750 msec, sampled from an exponential distribution).

Figure 4.1 Charitable donation task design. On 2/3 of trials the charity description was shown, followed by a screen showing the finger-response mappings, number of tokens earned, and requested a donation response. On the other 1/3 of trials the charity description was shown as before but the donation slide was replaced with a visual fixation slide. After all trials there was a 500 ms visual fixation and then the inter-trial interval.



Charities were modeled after a previous behavioral study (Vickers & Preston, in prep) by varying the framing to emphasize the nurturant vs. heroic aspect and the passive vs. active aspect. This format allowed us to control for each type of victim and aid (e.g., helping capsized boaters) while varying our dimensions of interest. For example, if the victims were capsized boaters, the four frames could be Coast Guard teams jumping into the water (heroic-active), administering warming and rehydration treatments (nurturant-active), designing harnesses for the Coast Guard teams (heroic-passive), or funding charities supplying blankets and dehydration treatments to the Coast Guard (nurturant-passive).

During charity portions of the trial, subjects were instructed to read and pay attention to the charity on the screen for 5500 msec, which was followed by 500 msec of visual fixation. After 2/3 of the trials in each run, subjects were then shown the number of tokens they "earned" and given a chance to donate. In order to increase task motivation, subjects were told they earned tokens based on their neural activity in response to the charity slides, but in reality token

amounts were random odd numbers between 5 and 9 pulled from a uniform distribution. Button-response mappings were displayed on the screen during donation trials—participants pressed their left pinky for donations of 0 tokens and their right pinky to donate 9 tokens, with each finger in between increasing the donation by one token. Participants were not allowed to donate more tokens than they earned on that trial, the amount donated was shown on the screen after a response was given, and earned tokens were equated between subjects. Tokens did not carry over from trial to trial (i.e., on each trial, non-donated tokens are added to a bank of saved tokens, but participants could not donate banked tokens). Subjects were allowed 3500 msec to donate, followed by 500 msec fixation and then the ITI. On charity only trials, the donation screen was filled with an equivalent fixation time.

In all trials, the fixation cursor changed colors from black to green at the trial onset with the charity description. The fixation cursor changed from green back to black 500 msec after the charity offset to signal that the they should make a donation response (charity viewing and donation trials) or that the task was over (charity only trials).

Motor tapping localizer. To localize primary motor regions of the brain, subjects were cued to either "tap fast" or "rest." During tapping blocks, subjects pressed with their left and right index fingers to the beat of a changing cursor for 20 seconds. During rest blocks, subjects relaxed for 20 seconds. Blocks of tapping and rest were repeated three times in the run.

Grabbing visualization localizer. In order to isolate areas of the brain involved in more complex motor procedures, 15 images of objects were pulled from the International Affective Picture System database (Lang, Bradley, & Cuthbert, 2008). Images included objects such as books, dinnerware, and tools. At the beginning of each image block, a two-second cue at the top of the screen told participants to either "GRAB" or "WATCH" the images. The cue remained on

the screen while five images were presented for four seconds each. During grab blocks, subjects visualized reaching out, grabbing the image with both hands, and bringing it toward them. During watch blocks, subjects watched images on the screen passively without any visualization. Each block type was presented three times and blocks alternated between grab and watch blocks (first block counterbalanced between subjects). Twenty-second rest periods were given between each block.

Nurturance localizer. Thirty images were pulled to isolate areas involved in responses to infants compared to adults to localize areas associated with the MCMA. Prior work has shown that "baby schema" activate the NAcc (Glocker et al., 2009) and that viewing baby faces activate the orbitofrontal cortex (OFC; Kringelbach et al., 2008). Additionally, first-time mothers activate many areas of the MCMA in response to their own infants including the VTA, striatum medial PFC, anterior cingulate cortex (ACC), and dorsolateral PFC (Glocker et al., 2009; Strathearn, Li, Fonagy, & Montague, 2008). Fifteen babies and 15 adults (half female) were displayed separately in 20-second blocks, with each image presented for four seconds. Subjects were instructed to watch the images on the screen. As in the grabbing localizer, each block type was presented three times in an alternating sequential order (first block counterbalanced between subjects) with 20-second rest periods between each block.

Charity ratings and personality questionnaires. After exiting the scanner, subjects rated charities and filled out personality questionnaires in a waiting area. They rated each charity on 7-point scales reflecting its (1) importance to society (1 = Very unimportant, 7 = Very important), (2) importance to them personally (1 = Very unimportant, 7 = Very important), (3) extent that feelings associated with nurturant vs. heroic actions were elicited (1 = Moved, touched, softhearted; 7 = Alarmed, activated, vigilant), and (4) level of physicality or energy

involved in the activity as a proxy for passive vs. active (1 = Very low, 7 = Very high). Personality questionnaires included the 30-item Penner Prosocial Battery (Penner, Fritzsche, Craiger, & Freifeld, 1995) to assess individual differences in empathy and Happiness Spending Inventory (Dunn, Aknin, & Norton, 2008) to assess difference in how much people enjoy spending on others. Multiple scales assessed the degree to which people prioritize careful thinking compared to jumping into action (Locomotion Assessment Scale; Kruglanski et al., 2000), intuition (Preference for Intuition and Deliberation Scale; Betsch, 2004), and not liking to think (Need for Cognition Inventory; Cacioppo, Petty, Feinstein, & Jarvis, 1996) in case overthinking diminished the effects of charity framing on donations.

Data acquisition. Visual stimuli were presented using E-Prime 2.0 software onto a screen at the back of the bore of the magnet that participants viewed through a mirror. Imaging data were acquired using a 3.0 T GE Signa scanner with the standard head coil. To measure the blood oxygen level dependent (BOLD) signal for each participant in the main task, we acquired 684 functional T2* weighted spiral in/out BOLD fMRI for increased signal to noise ratio (SNR) volumes (slice thickness = 4 mm, 29 slices, repetition time [TR] = 2000 msec, echo time [TE] = 1700 msec, flip angle [FA] = 30°, in plane resolution = 3.44 x 3.44 mm) divided evenly across four runs. Localizer tasks for motor tapping, grabbing visualization, and nurturance were acquired with the same parameters but with 78, 150, 125 volumes respectively. Data was not collected until after the first 5 functional images to allow for steady state magnetization. Structural images for data presentation and co-registration were acquired in the same slice locations using a T1-weighted fast gradient echo pulse sequence (TE/FA = 30ms/90 degrees, in plane resolution = 0.859 x 0.859 mm), and high resolution structural images (voxel size 1 x 1 x 1 mm) were collected using a T1-weighted, spoiled 3D GRE acquisition.

Analysis of BOLD Activation

Preprocessing. Functional data were preprocessed and analyzed according to the general linear model with Statistical Parametric Mapping 8. The four runs of the charity task were spatially realigned to compensate for head-movements, "time-sliced" using sinc-interpolation to compensate for time-lag between subsequent slices, spatially normalized to the Talairach and Tournoux Atlas, and spatially smoothed using a Gaussian filter of 5.0-mm full-width half-maximum to reduce spatial noise and to compensate for anatomical differences among the subjects.

fMRI analysis during charity donations task. After preprocessing, eight regressors were created to model task events: one regressor was included for each of the four trial types (passive-nurturant, passive-heroic, active-nurturant, active-heroic) during the charity viewing period, and another four regressors for each trial type were included during the donation period for Charity & Donation trials. Each regressor was modeled as a block with duration equal to the time it was displayed (Charity Viewing = 5.5 sec, Donation = 3.5 sec), and for each regressor the temporal derivative was included to model variance. Additional nuisance regressors were included for the intercept of the run (4 regressors), each of the translation and rotation head movement parameters (6 regressors per run), and two regressors of no interest for each of the 12 omitted charities (described in more detail below). A random effects analysis was then performed in which the contrast images from all subjects for a given contrast were submitted to an ANOVA, and differences in the canonical contrasts presented (differences in the temporal derivative are not discussed). This is a population test where the significance values assigned to each voxel indicate the likelihood of its being activated in the whole population from which the

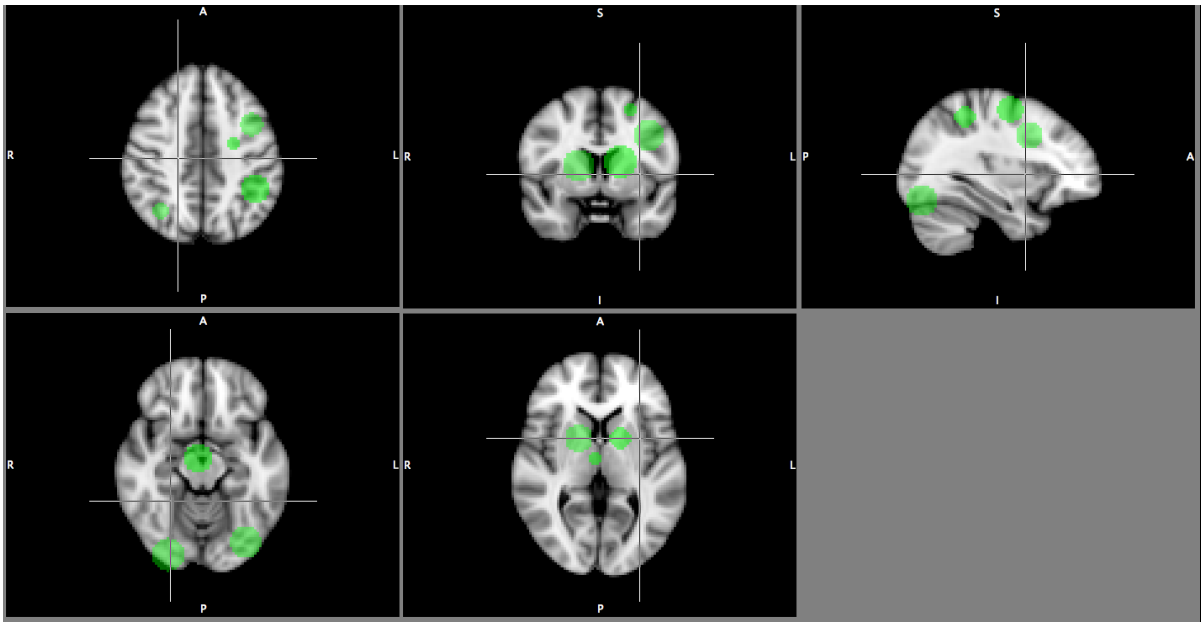
sample has been drawn. Whole-brain results are presented at $p < .05$ with a family-wise error correction for multiple comparisons.

Continuous parametric ratings. To provide convergent evidence, an additional parametric analysis was conducted. Each of the passive vs. active and nurturant vs. heroic ratings were averaged across subjects to provide a composite score for each charity. Two regressors per run modeled the Charity period and Donation period. Additional parametric effects modeled the extent to which each charity was viewed as passive vs. active (centered) and nurturant vs. heroic (centered). Second-level analyses are conducted using the same process as the above model.

Region of interest (ROI) analyses. The same ROI analyses were used for all analyses (i.e., for *a priori* charity classifications and continuous parametric analysis). Follow-up ROI analyses were conducted for both the 2x2 ANOVA and the model with continuous parametric ratings. Six ROIs were identified in a prior study of charitable donations (Moll et al., 2006). These six ROIs included the left DLPFC, left and right fusiform cortices, midbrain VTA, right superior temporal sulcus/angular gyrus (STS), and left and right striatum. Two additional ROIs were created from the grabbing visualization localizer, which was processed using the same method as above but with regressors for the grabbing, watching, and rest blocks. Comparing grabbing to watching produced two significant clusters at $p = .05$ FWE in the left parietal lobe (-42, -44, 50) and left premotor area (-24, -8, 56). Spheres were created at the center of each peak with a 13.0-mm radius, displayed in

Figure 4.2. All ROI analyses were Bonferroni corrected by the number of ROIs (as in Kwak, Müller, Bohnen, Dayalu, & Seidler, 2012) for an effective threshold of $p = .0056$ uncorrected. Since these ROIs covered the majority of areas associated with the MCMA, no additional ROIs were created from the nurturant localizer.

Figure 4.2. Regions of interest used for the analysis of imaging data. Regions included the left dorsolateral prefrontal cortex, left parietal cortex, left pre-motor cortex, right superior temporal sulcus, midbrain/VTA, left and right striatum, and left and right fusiform. Images are presented in radiological format (left side of the image is the right side of the brain).



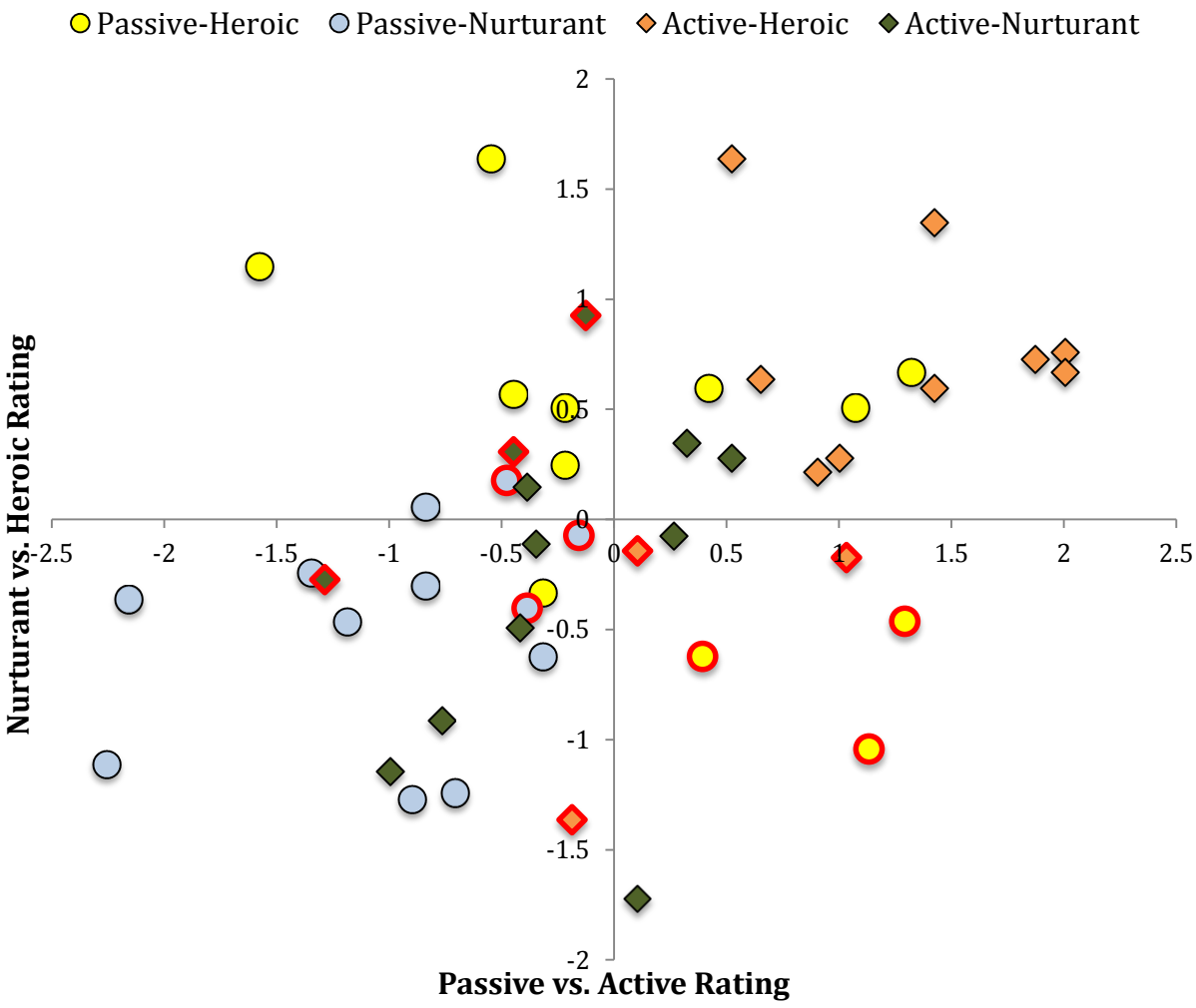
Results, 2x2 ANOVA

Manipulation check

Upon review of the data, multiple charities did not fit into their assigned categories so the 3 charities in which participant ratings strayed furthest from the intended categorization were removed from each category, leaving 9 per category for analysis (see removed charities in red in

Figure 4.3). active charities (M = 4.95, se = 0.11) were rated as more active than the passive charities (M = 3.82, se = 0.16), $t(28) = -8.87$, $M_{\text{passive-active}} = -1.13$, 95% CI = (-1.39, -0.87), $p < .001$, $\eta_p^2 = 0.73$. Heroic charities (M = 4.32, se = 0.25) were rated as more heroic than the nurturant charities (M = 3.01, se = 0.13), $t(28) = 5.14$, $M_{\text{heroic-nurturant}} = 1.31$, 95% CI = (0.79, 1.83), $p < .001$, $\eta_p^2 = 0.49$.

Figure 4.3. Scatterplot of mean-centered charity ratings on the passive vs. active ratings (x-axis) and nurturant vs. heroic ratings (y-axis). More negative numbers represent more passive and nurturant charities, and more positive numbers represent more active and heroic charities. Charity types are colored, and charities that have been circled in red were removed from analysis.



Donations

Donations were analyzed using the percent of total tokens donated to each type of charity. Overall, subjects donated marginally more to nurturant than heroic charities, $F(1,28) = 3.73$, $p = .064$, $\eta_p^2 = 0.12$. There was no effect of passive compared to active charities, nor was there an interaction between passive vs. active and nurturant vs. heroic charities, Fs$(1,28) < 1.50$, ps $< .20$. When including gender in the overall model, all statistics remained at the same levels of

significance. There were no differences in reaction times between any charity types or gender so they are not discussed further.

BOLD Activation During Charity Donations Task

Using the 2x2 ANOVA, whole-brain effects were found in both the Charity and Donation period in the right anterior insula, dorsal medial prefrontal cortex (DMPFC), bilateral parietal cortex, right dorsolateral prefrontal cortex (DLPFC), left inferior temporal gyrus, and primary visual cortex for all conditions contrasted against rest. In the Charity period there were also effects in the left anterior insula, bilateral premotor area, cerebellum, and right somatosensory cortex for all charity framings versus rest. The Donation period had unique activity in the left fusiform face area, right VLPFC, left temporal pole, thalamus, posterior cingulate, medial OFC, hypothalamus, and primary motor cortex for all charity framings versus rest (Table 4.1). No effects of charity type were found at the .05 FWE level.

Table 4.1. Whole-brain results for charity and donation period greater than rest. All effects are significant at a $p < .05$ with family-wise error correction.

		Cluster		Peak				
Period	**Area**	p_{FWE}	**Voxels**	p_{FWE}	p_{unc}	**x**	**y**	**z**
Charity	R Anterior Insula	< .001	397	< .001	< .001	34	26	-4
	DMPFC	< .001	3189	< .001	< .001	10	24	40
				< .001	< .001	-4	14	46
	L Premotor			< .001	< .001	-42	-2	58
	Posterior Cerebellum	< .001	1666	< .001	< .001	-16	-92	-20
	Posterior Occipital			< .001	< .001	-6	-98	-10
				< .001	< .001	18	-94	-10
	L Anterior Insula	< .001	349	< .001	< .001	-32	24	-4
	R Premotor	< .001	668	< .001	< .001	36	-12	60
				< .001	< .001	34	-4	60
				0.020	< .001	46	6	50
	L Parietal Lobule	< .001	541	< .001	< .001	-30	-58	46
	R Parietal Lobule	< .001	374	< .001	< .001	34	-54	50
				0.001	< .001	26	-64	50
	L Fronto-Parietal Junction	0.002	72	0.003	< .001	-44	-34	42
	R DLPFC	< .001	122	0.003	< .001	52	30	30
	R Primary Somatosensory	0.005	41	0.005	< .001	46	-26	46
	R DLPFC	0.005	42	0.012	< .001	46	8	28
	L Posterior Inferior Temporal Gyrus	0.010	24	0.016	< .001	-58	-44	0
	Posterolateral Occipital	0.014	17	0.022	< .001	-30	-98	0
Donation	R Parietal	< .001	3942	< .001	< .001	48	-40	58
				< .001	< .001	38	-60	48
				< .001	< .001	12	-74	56
	R Posterior Occipital	< .001	8454	< .001	< .001	22	-86	-16
				< .001	< .001	-38	-84	-18
	L Fusiform			< .001	< .001	50	-62	-18
	DMPFC	< .001	6372	< .001	< .001	14	28	54
				< .001	< .001	-4	36	34
				< .001	< .001	-8	20	56
	L Parietal	< .001	2348	< .001	< .001	-50	-36	56
				< .001	< .001	-30	-64	56
				< .001	< .001	-34	-64	48

		Cluster		Peak				
Period	**Area**	p_{FWE}	**Voxels**	p_{FWE}	p_{unc}	**x**	**y**	**z**
	R Anterior Insula	< .001	2919	< .001	< .001	42	20	-12
	R DLPFC			< .001	< .001	48	34	22
	R VLPFC			< .001	< .001	44	50	-8
	L Temporal Pole	< .001	1058	< .001	< .001	-48	18	-16
	L VLPFC			< .001	< .001	-44	46	-10
				< .001	< .001	-44	26	-10
	L Premotor	< .001	998	< .001	< .001	-38	16	50
				< .001	< .001	-54	16	32
	R Posterior Thalamus	< .001	145	< .001	< .001	26	-28	2
	R Posterior Inferior Temporal Gyrus	0.005	45	< .001	< .001	62	-34	-16
	R Thalamus	< .001	143	0.001	< .001	16	-10	6
	L Inferior Temporal Gyrus	0.001	100	0.001	< .001	-62	-28	-16
				0.003	< .001	-60	-18	-20
				0.045	< .001	-60	-42	-14
	Posterior Cingulate	< .001	149	0.001	< .001	0	-22	32
	Medial OFC	0.018	13	0.004	< .001	2	34	-20
	L Thalamus	0.008	32	0.010	< .001	-12	-6	4
	Hypothalamus	0.024	8	0.016	< .001	2	-10	-12
	Paracentral Lobule	0.023	9	0.018	< .001	0	-28	74
	L Primary Motor	0.037	2	0.034	< .001	-46	0	-26
	R Occipital	0.032	4	0.046	< .001	30	-80	20
	L Posterior Thalamus	0.042	1	0.049	< .001	-24	-30	2

ROI analysis. During the Charity Period but not the donation period, the midbrain VTA and left DLPFC ROIs were activated by heroic charities. During the Charity period, heroic charities also activated the right fusiform, right STS, and left parietal ROIs more than nurturant charities, but all of these effects were qualified by an interaction between heroic/nurturant and passive/active charities (interaction effects in Figure 4.4). This interaction also showed up in the left fusiform and left premotor ROIs, and all effects were due to the same charity types. Across all ROIs the passive-heroic charities were associated with more activation than the passive-nurturant charities. Additionally, the passive-nurturant charities were associated with lower

activation than both active charity types in both fusiform ROIs and in the STS. Passive-nurturant charities had lower activation than active-nurturant charities in the parietal ROI.

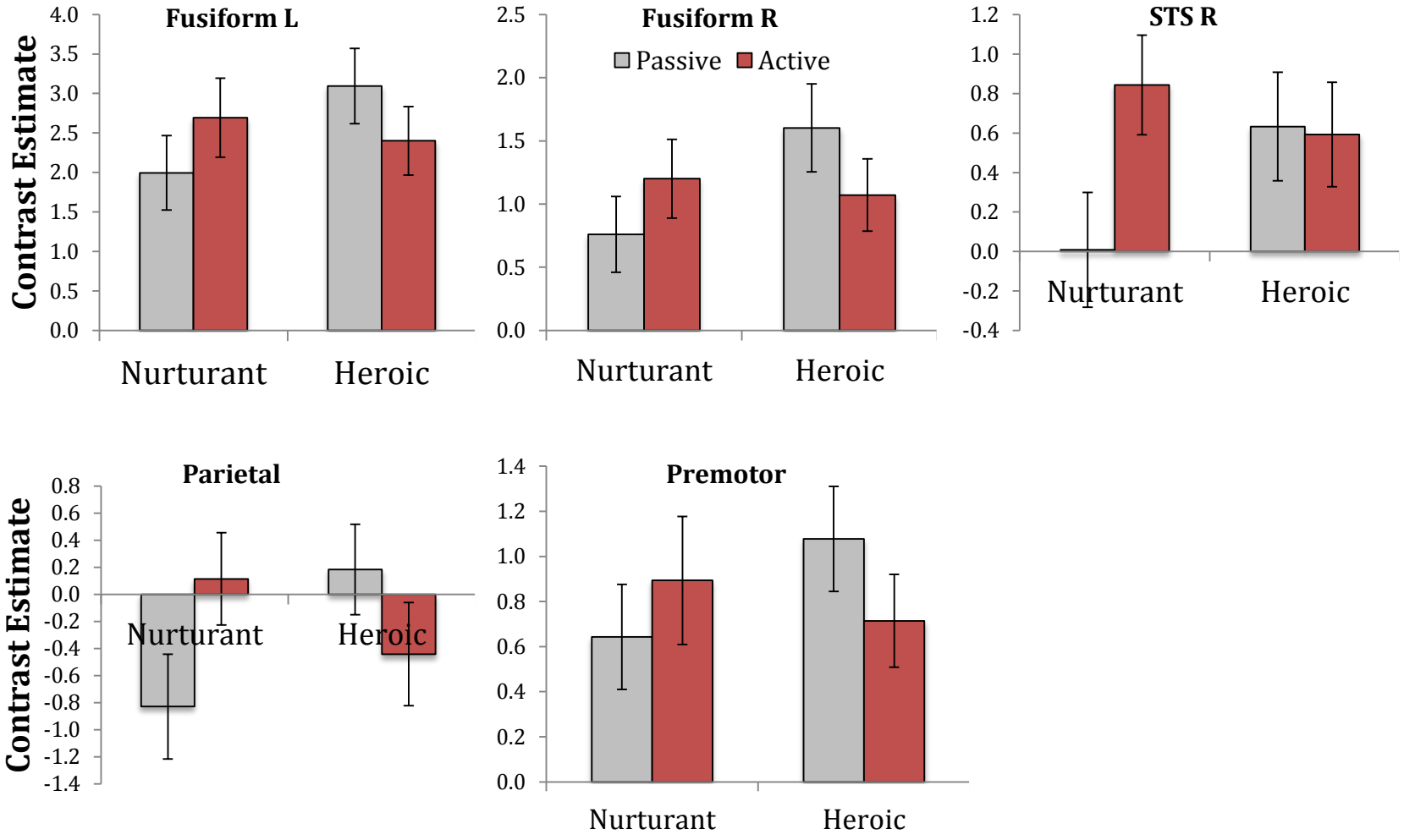
During the Donation period, nurturant charities were associated with higher activation in the left parietal ROI, and heroic charities were associated with more activation in the left premotor ROI. No interactions reached significance during the Donation period for the ROI analysis. All effects are displayed in

Table 4.2.

Table 4.2. Results from the region of interest analysis in the 2x2 ANOVA. All effects Bonferroni corrected by the nine regions of interest.

Period	Contrast	ROI	t	z	*p*	x	y	z
Charity	Active > Passive	STS R	2.75	2.65	0.004	28	-72	38
	Nurturant > Heroic	DLPFC L	2.83	2.72	0.003	-48	2	36
			2.71	2.61	0.004	-42	-4	40
		Fusiform R	3.12	2.99	0.001	24	-78	-16
		Midbrain VTA	3.25	3.10	0.001	6	-12	4
		STS R	2.75	2.65	0.004	32	-68	32
		Parietal	3.65	3.44	< .001	-52	-48	44
	Interaction	Fusiform L	2.80	2.70	0.004	-22	-78	-18
		Fusiform R	3.45	3.27	0.001	24	-78	-10
		STS R	2.90	2.78	0.003	26	-70	38
			2.84	2.73	0.003	26	-72	34
		Parietal	3.61	3.41	< .001	-42	-48	60
			3.09	2.96	0.002	-48	-42	48
		Premotor	2.74	2.64	0.004	-26	-10	44
Donation	Nurturant > Heroic	Parietal	3.04	2.91	0.002	-50	-48	44
	Heroic > Nurturant	Premotor	2.67	2.58	0.005	-28	-14	46

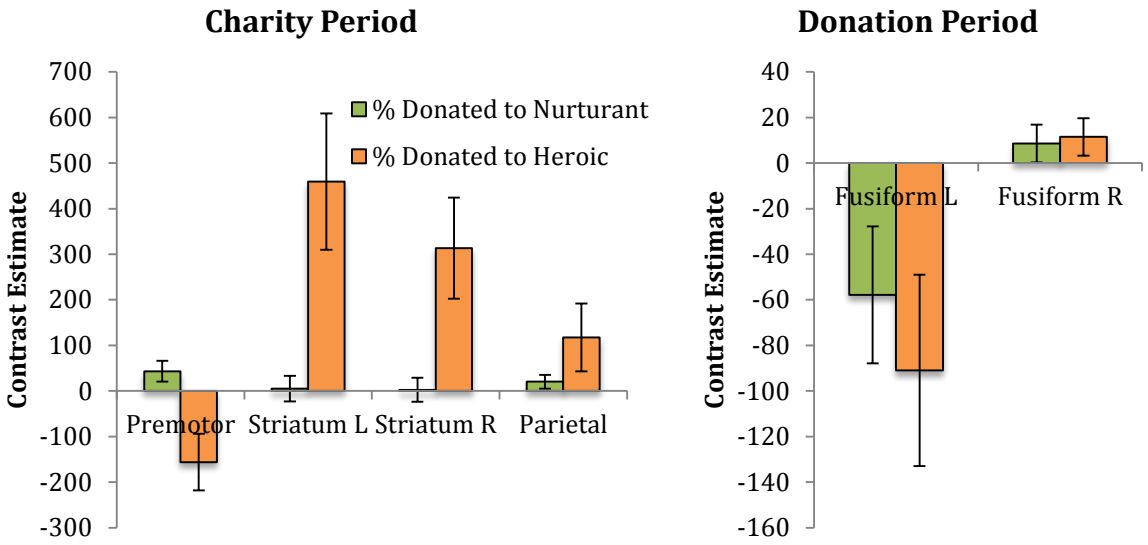
Figure 4.4. Contrast estimates of fMRI interaction effects during the Charity period in the 2x2 ANOVA. Gray bars represent estimates for passive charities and red bars represent active charities. Error bars represent one standard error of the mean.



Gender differences in charity donation task. The follow-up model tested whether there were any gender differences in the 2x2 ANOVA. During the Charity period, males showed stronger activation to passive charities than females in the midbrain VTA ROI, $p = .001$, (x,y,z) = (10, -2, -8), but there was no difference in activation for active charities. There were also two gender interactions with the passive vs. active by nurturant vs. heroic interaction in two ROIs, *p*s < .003 (premotor x,y,z = -16, -10, 52; striatum x,y,z = 16, -6, 18). The premotor effect during the Charity period and striatum effect during that donation period were driven by females having more activation in response to heroic-passive and active-nurturant charities than males, plotted in Figure 4.6.

Regressors for Percent Donated. To investigate whether any of the effects were correlated with the percent of tokens that participants donated, the 2x2 ANOVA was fit with additional regressors for the percent donated to each charity type. During the charity period, increased activation in the left and right striatum and parietal ROIs were associated with more donations to heroic charities, *t*s > 2.90, *p*s < .002, but activation in these areas was not reliably associated with donations to nurturant charities. In the premotor ROI, increased activation was associated with *lower* donation to heroic charities, and higher donations to nurturant charities, $t = 3.26$, $p = .001$. During the Donation period, activation in the left fusiform was associated with decreased donations to both nurturant and heroic charities, and the effect was stronger for heroic than nurturant charities, *t*s > 2.60, *p*s < .005. The fact that activation toward heroic charities in the premotor and fusiform cortices is in-line with the idea that preparing for and visualizing heroic actions more may overwhelm subjects and lead to decreased donations. A slight positive effect was found in the right fusiform, but only in a single voxel so we do not explore it. All results are plotted in Figure 4.5.

Figure 4.5. Regions of interest that predict differences in the percent of tokens donated to nurturant and heroic charities in the 2x2 ANOVA. Error bars indicate one standard error of the mean.

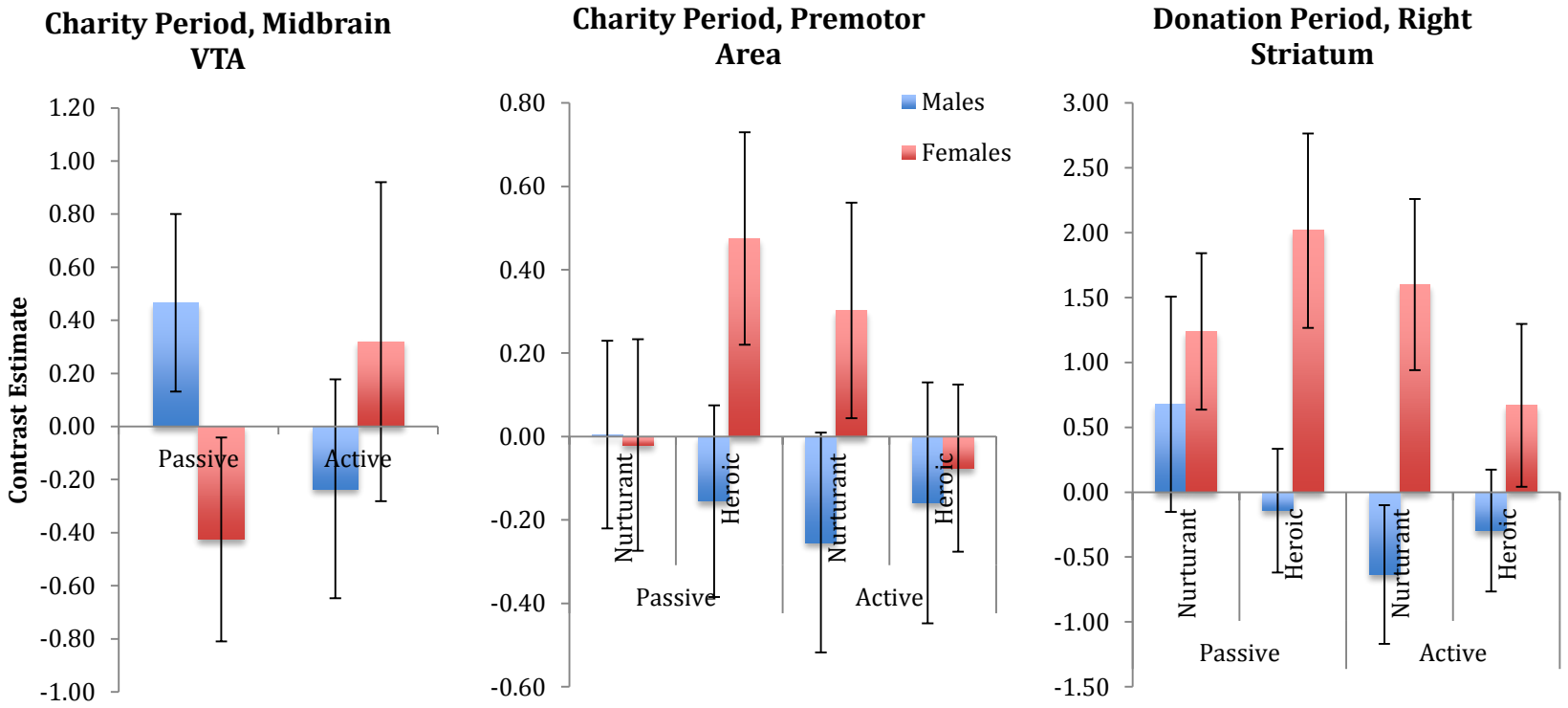


Results, Parametric Ratings Analysis

Donations

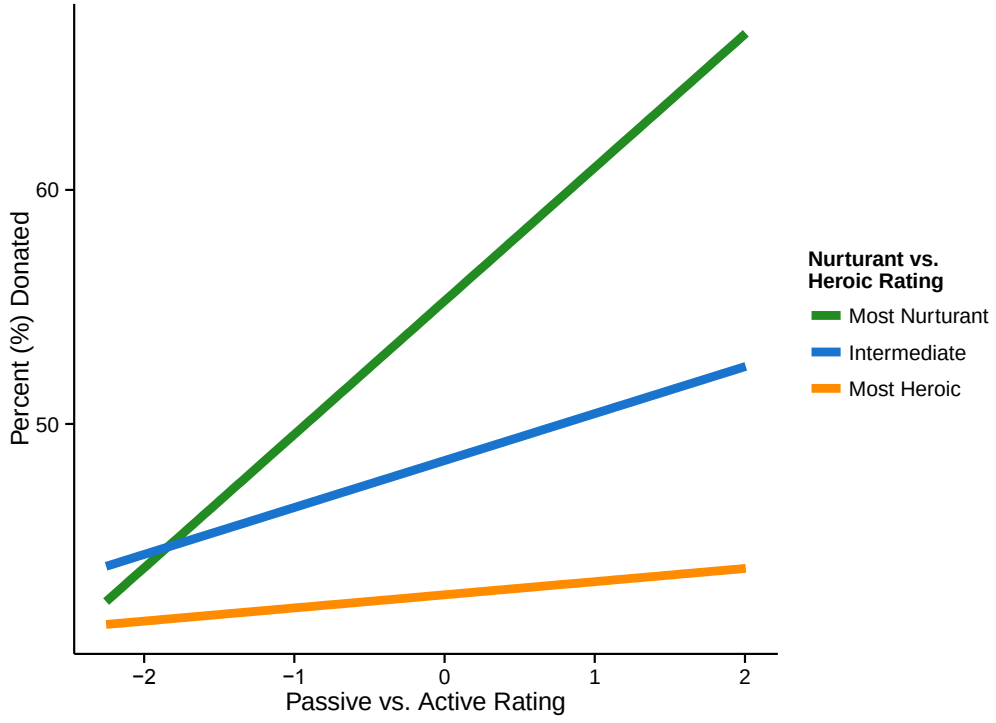
Analysis of donations using the mean ratings on the passive vs. active and nurturant vs. heroic scales was done using a linear mixed model to estimate effects of individual charities at the group level. Ratings for each charity were averaged across subjects on the passive vs. active scale and nurturant vs. heroic scale, and the one to seven ratings were mean-centered for statistics. We also used individual subjects' ratings in statistics (i.e., not collapsing charity ratings across subjects) and results remained very similar, but due to lower variability they are not presented here.

Figure 4.6. Contrast estimates for gender differences in the 2x2 ANOVA by region of interest (ROI). The period and ROI are displayed on the top, with blue bars showing effects for males and red bars showing effects for females. Error bars represent one standard error of the mean.



Subjects donated 2.4% more tokens as charities became one unit more active, β = 2.42, *se* = 0.53, *t* = 4.53, *p* < .001, and donated 5.9% more as charities became one unit more nurturant, β = -5.91, *se* = 0.69, *t* = -8.58, *p* < .001. These effects were qualified by an interaction between the two rating scales. The slope of the passive vs. active effect in more nurturant charities was higher than the slope for more heroic charities, β = -3.05, *se* = 0.69, *t* = -4.45, *p* < .001. In other words, for charities that were lower than the mean on the nurturant vs. heroic scale, the slope of the passive vs. active ratings on donations was positive and significant, β = 5.39, *t* = 6.22, *p* < .001, but the slope was negative and not significantly different from zero for charities that were higher than the mean on the nurturant vs. heroic scale, β = -0.60, *t* = -0.89, *p* = .374, see Figure 4.7.

Figure 4.7. Interaction between nurturant vs. heroic and passive vs. active ratings on donations. For the most nurturant charities, participants donated more as charities became more active. For the most heroic charities, how passive vs. active the charity was did not influence donations.



When including gender in the model, the effect of passive vs. active ratings remained positive and significant, $\beta = 1.03$, $t = 3.18$, $p < .001$. The overall effect of nurturant vs. heroic ratings fell to a non-significant level, $\chi(1)^2 = 0.02$, $p = .879$, but this omnibus effect was qualified by an interaction between nurturant vs. heroic ratings and gender, $\chi(1)^2 = 12.12$, $p < .001$. Both males and females donated significantly more as charities were rated as more nurturant, but this effect was significantly larger in males, males: $\beta = -8.61$, $t = -8.84$; females: $\beta = -3.22$, $t = -3.32$. The interaction between passive vs. active and nurturant vs. heroic ratings fell to a marginal level of significance, $\chi(1)^2 = 3.72$, $\beta = 0.33$, $t = 2.18$, $p = .054$.

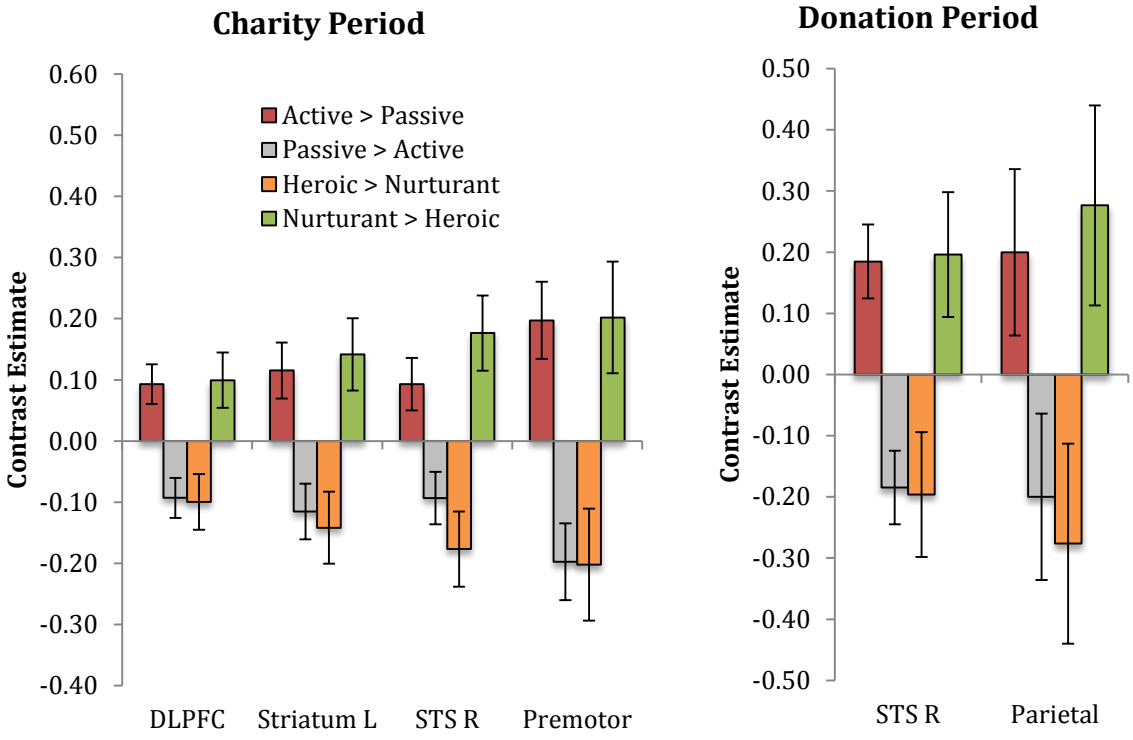
BOLD Activation to Parametric Regressors

With the regressors for passive vs. active and nurturant vs. heroic ratings, most effects were found during that Charity portion of the task. During the Charity period, the positive linear effect of active over passive ratings was associated with higher BOLD signal midbrain VTA ROI. There was also a linear effect of active > passive ratings in the left DLPFC, left striatum, right STS, and left premotor ROIs, *t*s > 2.60, *p*s < .005, but these were all qualified by an interaction with the nurturant vs. heroic ratings, *t*s > 2.80, *p*s < .004. For all of these interactions there was a higher BOLD signal for active and nurturant charities compared to passive and heroic charities. During the donation period, BOLD signal in the right STS increased as charities were rated as more active, $t = 3.12$, $p = .001$. Both the STS and parietal ROIs showed the same interaction as the prior ones, *t*s > 2.60, *p*s < .005, with BOLD activation increasing more for active and nurturant charities compared to passive and heroic ones, plotted in Figure 4.8.

Table 4.3. Results of the region of interest analysis based on parametric effects on the passive vs. active and nurturant vs. heroic ratings scales. All effects surpass the Bonferroni corrected threshold.

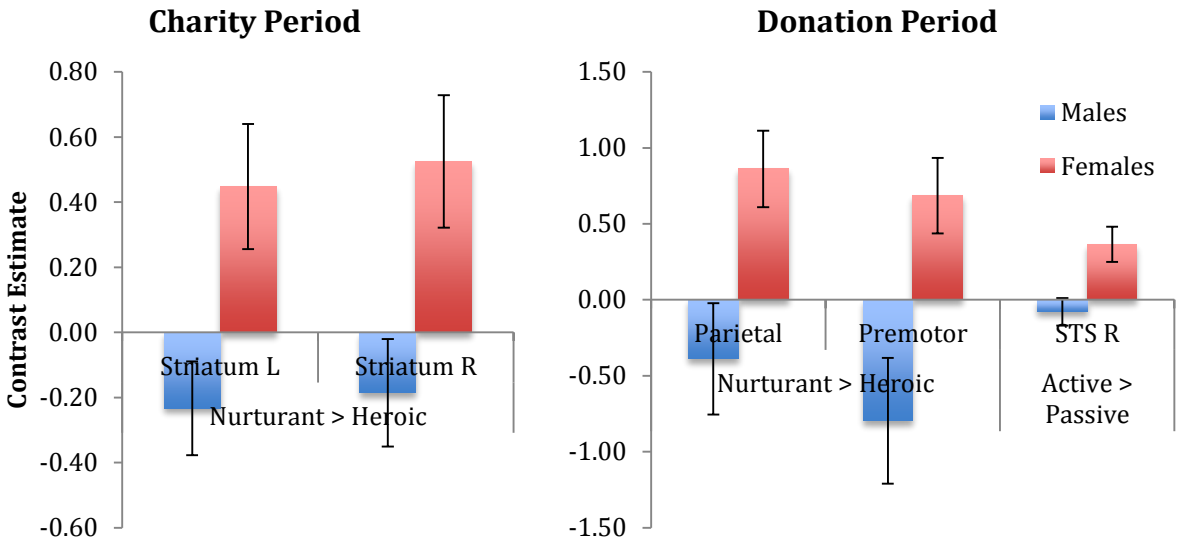
Period	Contrast	ROI	*t*	z	*p*	x	y	z
Charity	Active > Passive	DLPFC L	3.40	3.23	0.001	-48	6	44
			3.36	3.19	0.001	-38	-2	44
			3.15	3.01	0.001	-30	4	34
			2.80	2.69	0.004	-46	14	28
			2.69	2.59	0.005	-38	2	24
			2.69	2.59	0.005	-34	4	24
		Midbrain VTA	3.02	2.89	0.002	4	-18	-2
			2.96	2.84	0.002	2	-24	-6
		STS R	2.89	2.77	0.003	40	-52	36
			2.70	2.61	0.005	32	-68	32
			2.64	2.56	0.005	38	-74	30
		Striatum L	3.13	2.99	0.001	-6	10	18
		Premotor L	3.26	3.11	0.001	-34	0	56
			3.19	3.04	0.001	-36	-4	54
			2.63	2.54	0.006	-32	-2	48
	Nurturant > Heroic	STS R	2.92	2.80	0.003	34	-52	38
			2.82	2.72	0.003	40	-56	42
	Act/Pas * Hero/Nurt	DLPFC	3.14	3.00	0.001	-30	2	28
			3.01	2.89	0.002	-44	6	46
			2.90	2.78	0.003	-48	6	44
		Striatum L	3.64	3.44	< .001	-24	4	24
		STS R	3.05	2.92	0.002	36	-52	38
		Premotor	3.38	3.21	0.001	-34	0	58
			3.10	2.97	0.002	-32	0	50
			2.71	2.62	0.004	-26	4	60
			2.83	2.72	0.003	-22	-16	62
Donation	Active > Passive	STS R	3.12	2.99	0.001	30	-54	26
		Premotor L	2.95	2.83	0.002	-30	-18	52
			2.88	2.77	0.003	-28	-18	62
			2.87	2.76	0.003	-28	-20	58
	Nurturant > Heroic	Parietal L	2.68	2.59	0.005	-34	-44	60
	Act/Pas * Hero/Nurt	STS R	3.22	3.07	0.001	32	-56	24
		Parietal L	2.63	2.55	0.005	-36	-36	54

Figure 4.8. Contrast estimates for the interaction between passive vs. active and nurturant vs. heroic ratings. All interaction effects show higher BOLD signal in areas for active and nurturant charities compared to passive and heroic charities. Error bars represent one standard error of the mean.



Gender differences in the parametric ratings analysis. When including gender in the model, the linear effect in the bilateral striatal ROIs led to higher activation as charities became more nurturant in females, but led to higher activation as charities became more heroic in males, *t*s > 2.50, *p*s < .005. During the Donation period, a similar effect was found in the parietal and premotor ROIs where females showed more activation with more nurturant charities but males showed more activation with more heroic charities, *t*s > 2.75, *p*s < .003. Additionally, the linear effect of active charities led to higher activation in the right STS in females but there was no effect in males, $t = 3.00$, $p = .002$, all plotted in Figure 4.9. None of the two-way interactions showed an additional interaction with gender at the Bonferroni corrected threshold.

Figure 4.9. Gender interactions in the parametric model comparing passive vs. active and nurturant vs. heroic ratings. Blue bars depict the effect in males and red bars depict the effect in females. Error bars represent one standard error of the mean.



Discussion

Overall, while we did not find evidence for differences in donations depending on our *a priori* charity types, we did find differences in neural activation to these charity types. The VTA was more active for heroic compared to nurturant charities, and many of the differences in neural activation were qualified by an interaction. Heroic-passive and nurturant-active charities led to higher activation in a range of areas, including the DLPFC, bilateral fusiform cortices, STS, parietal, and premotor ROIs. This was unexpected, and may be due to different underlying processes.

All of the ROIs from Moll were taken from areas involved in reward and charitable donations. This suggests that nurturant charities that are framed in a more present, active sense may be processed in a more prosocial, rewarding way. This could be because they can imagine themselves helping the other without any fear of danger to themselves. However, the processing of heroic charities may be hindered when they are framed in a more present, active sense because

heroic-active helping tends to require motor expertise that subjects are not familiar with, and dangerous actions. If participants are putting themselves into the helper's perspective in these situations it may actually backfire because it produces more activation along the aversive, fear-related processing stream, leading to less robust activation of the charitable donation circuit. To test this we are recruiting additional subjects and investigating whether people who imagine themselves as the helper in heroic-active situations response with more negative, aversive feelings.

While we did not hypothesize any specific gender differences in the ROIs, we did find a few. Interestingly, VTA, reward-related activation was associated with the hypothesized active charities in females but was associated with passive charities in males. The MCMA does not lay out specific gender differences, but the rodent retrieval responses that it is partially based on have been studied in the female dams, leading to the possibility that it is a gender-specific response. Supporting this idea, females showed increased brain activation in response to heroic-passive and nurturant-active charities compared to males, who showed no differences in neural activation, even though they also rated the charities differently. Future research will need to follow-up on this to investigate whether the proposed MCMA is primarily functioning in females and may follow a different route in males, whether females and males evaluate charities based on different processes (e.g., imagining themselves as the helper or not), or whether females and males weight charity attributes differently.

Since our *a priori* charities were not well differentiated on the passive vs. active and nurturant vs. heroic rating scales we ran additional analyses using parametric tests of effects. Behaviorally, effects of our prior work were replicated. Charities that were rated as more active received increased donations, and charities that were rated as more nurturant received increased

donations. Additionally, there was an interaction between ratings such that nurturant-active charities received the highest donations. These results were much more in line with our prior studies that showed large effects for active compared to passive charities. This analysis reflects how participants *perceive* the charities rather than the categories that we put them into, so if the MCMA neural activation is associated with *perceived* attributes of the charities then this analysis should produce neural differences that are more in line with the MCMA and our hypotheses.

In line with prior studies that found activation of the VTA, striatum, and DLPFC in response to images of their own infants (Strathearn et al., 2008), active charities led to increased activation in the VTA, left striatum (and right striatum at lower thresholds), DLPFC, STS, and premotor area. This suggests that perceptions of the charities may map onto the MCMA hypotheses more directly than the *a priori* categories that we had classified charities into. Here we also found that many areas came online with the conjunction of active and nurturant charities—the same types of charities that received increased donations—including the left striatum, DLPFC, STS, and premotor area. It is notable that the VTA is the only area to come up as a main effect for active > passive ratings but not also nurturant > heroic ratings. Since the VTA is hypothesized to be part of the approach processing stream it should be active for all charities that lead to increased helping (more active and more nurturant), but it is a small structure that may be difficult to get a strong signal from using fMRI. Future research would benefit form further probing of the VTA compared to other effects and determine whether the VTA is more responsive to active than nurturant charities, or is more responsive to nurturant-active charities like the other areas.

There were fewer differences in the parametric model, but again they were driven by females showing stronger responses than males. Females showed stronger responses bilaterally

in the striatum, in the parietal ROI, and in the premotor area compared to males for nurturant charities. Additionally, females showed a stronger response in the STS to active charities compared to males. In the ratings, females rated the passive charities as more active compared to males, and the heroic charities as more nurturant compared to males. This suggests that females may be paying more attention to the active and nurturant aspects of charities compared to the males, which may also be why they are showing the increased activation. In order to test whether these differences are due to gendered processing of the charities, a follow-up study should have people focus on active-nurturant or passive-heroic aspects of the charities. If the differences are indeed due to attention allocation, the active-nurturant condition should lead to higher donations than the passive-heroic condition, whereas if they are due to gendered processing then we should again find that females are showing stronger activation across both conditions compared to the males.

Conclusion

This study builds upon the Maternal Caregiving Model of Altruism and prior work in our lab suggesting that active and nurturant charities elicit stronger donations than passive and heroic charities. While our initial analysis based on *a priori* charity types failed to find the hypothesized differences, using subjects' perceptions of the charities provided a much better fit with the MCMA. In line with the hypothesis that the Maternal Caregiving circuit is involved in helping behaviors, areas that are activated in response to pictures of infants (e.g., VTA, striatum, DLPFC) were brought online during charitable donations, and they were especially brought online in response to active and nurturant charities that were hypothesized to activate the Maternal Caregiving circuit the most. While this provides preliminary evidence that maternal caregiving circuits subserve some processing when making donation decisions, much work still

needs to be accomplished to help us understand how people make prosocial, charitable donations to others in need.

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Appendix 4A. Gender Differences in BOLD Activation

Table 4.4. Gender differences in the region of interest analysis with parametric effects on the passive vs. active and nurturant vs. heroic scales. All effects surpass the Bonferroni corrected threshold.

Period	Contrast	ROI	*t*	z	*p*	x	y	z
Charity	Heroic > Nurturant by Gender	Striatum L	3.00	2.87	0.002	-6	0	20
		Striatum R	2.68	2.59	0.005	6	0	16
Donation	Active > Passive by Gender	STS R	3.24	3.08	0.001	38	-58	26
			3.00	2.87	0.002	38	-70	32
	Heroic > Nurturant by Gender	Parietal L	2.96	2.84	0.002	-44	-32	54
		Premotor L	2.89	2.78	0.003	-36	-10	60

Chapter 5: General Discussion

Despite lean resources and self-professed desires to be sustainable and consume less, people still acquire and consume beyond their needs. These actions are partly subserved by transient and chronic affective states as well as differences in people's perceptions of options. This dissertation presented three studies that examined factors influencing people's resource allocation decisions using both specific emotions and predictions derived form their underlying appraisal dimensions. Together, this work suggests that uncertainty, anxiety, arousal, and sadness are all associated with resource allocation decisions.

What differentiates this work is the approach using appraisal theory, both with discrete emotions and with specific appraisal dimensions, to look at both acquisition- and discard-related phenomena. While the new focus of research linking emotions and decision making is investigating specific emotions, less research has shown strong evidence that any specific appraisal dimension is leading to the decision outcomes. Separating effects of appraisals from emotions themselves is extremely difficult using paradigms that manipulate emotions individually. Many of these studies have been effective at advancing our understanding and the field, but whether the results are due to a single appraisal dimension, multiple appraisal dimensions, or the interaction of appraisal dimensions is unclear.

One of the earliest and most robust effects of emotions on decision making has been of anger and fear on choices associated with risk and uncertainty. Anger is a high certainty, high individual control emotion whereas fear is a low certainty, low individual control emotion (Smith & Ellsworth, 1985). In one study (Lerner, 2001), angry people had more optimistic risk

assessments and were more risk-seeking than fearful people, and these effects were mediated by appraisals of individual control but not certainty. In another study comparing anger to sadness, angry people thought that ambiguous events were more likely to be caused by people, but there was no difference between the sadness and anger groups for non-ambiguous events (Keltner et al., 1993). In this article, the authors proposed that anger influenced choice because anger is associated with "perceptions of other people as responsible for one's misfortune." This draws upon the same appraisal dimension as the first study, individual responsibility. Because the same appraisal dimension is proposed to be the cause of both results, manipulating individual responsibility on its own should lead to differences in both risk preferences appraisals of events happening. However, this has not been done, and this approach of manipulating appraisal dimensions individually is seldom undertaken.

One published study took this approach and manipulated appraisal dimensions within a specific emotion, varying levels of certainty within sadness (Tiedens & Linton, 2001). The authors were interested in how different types of persuasive messages were received. Across multiple emotions, people who were experiencing certain emotions interpreted messages with a heuristic processing style compared to people who were experiencing uncertain emotions, who interpreted messages in a systematic processing style. In the final study, they varied the level of certainty within sadness and replicated the prior findings, providing convergent evidence that uncertainty itself was leading to differences in message processing. In Chapter 2, we found that anxiety, a low-certainty emotion, increased acquisitiveness. Due to its lower certainty than sadness, we manipulated certainty within sadness to investigate whether low-certainty sadness would lead to similar increases in acquisitiveness. Indeed, low-certainty sadness did lead to increases in consumption, but this was not the whole story. When subjects were a combination of

uncertain and sad they did not increase their acquisition rates. These interactive effects have not been demonstrated before and theoretically could be due to one of two reasons.

According to appraisal theories of emotion, there are varying appraisal dimensions with different prototypical emotions existing at different points along each of the dimensions (Scherer et al., 2001; Smith & Ellsworth, 1985). In this sense, reporting multiple dimensions suggest that subjects are closer across those dimensions. Considering that sadness and anxiety primarily differ on the appraisal dimensions of certainty and arousal, this suggests that one of these dimensions is causing decreased acquisitiveness. We found a similar effect in the patient sample presented in Chapter 3. Subjects with higher levels of depression and uncertainty were disinterested in scrap items that are low-value but could be used in many different ways. It is important to also note that in both of these studies participants reported feeling more emotions overall. The participants in Chapter 2 reported feeling both sadness and anxiety, and the patients in Chapter 3 reported feeling a variety of affective and other problems, including loss of interest in activities they enjoy, depression, worry, anxiety sensitivity, and emotional lability. While appraisal theories predict that the combination of emotions reduces acquisitiveness because people are moving to more certain affective states, there is an alternate possibility that higher numbers of negative emotions in and of themselves decrease acquisitiveness.

The hypothesis that higher levels of negative emotions can lead to debilitating outcomes has been suggested previously. Izard (1972), building on the work of Tomkins (Tomkins, 1963; Tomkins, 1962), wrote extensively on what he described as patterns of emotions, combinations of specific emotions that co-occur in regular patterns and have unique motivational-experiential characteristics. He proposed that affective disorders are composed of a number of specific affective states at the same time. In his framework, anxiety is composed of interest, low anger,

low contempt, and fear, whereas depression is composed of low interest, distress, anger, disgust, and contempt. In some of my other work, we have found that higher levels of negative states are associated with higher intensity affect and higher distress (Vickers, Carpenter, & Ellsworth, in prep), but we do not know whether they would lead to similar decreases in behavioral outcomes. Future research could follow up on this by using robust effects (e.g., anger and fear on risk attitudes) and seeing whether emotions produce effects in a U-shaped pattern, such that participants feeling moderate levels of fear are risk-averse but those feeling extreme levels of fear and other emotions are not as risk averse.

The appraisal framework can also help understand the effects of charitable donations in Chapter 4. Drawing upon the typical emotions that subjects experience in empathy tasks (Batson et al., 1987; Eisenberg & Fabes, 1990; Preston & Hofelich, 2012), empathic concern is associated with a suite of positive emotions such as feeling sympathetic, softhearted, warm, compassionate, and tender toward the other. Personal distress, on the other hand, is associated with a suite of negative emotions such as feeling grieved, troubled, distressed, upset, and worried. In the donations task (Chapter 4), the nurturant charities made participants feel more "moved, touched, and softhearted," emotions that are all much more aligned to empathic concern than personal distress.

Applying the appraisal tendencies framework suggests that when people experience higher arousal levels of empathic concern they are more likely and take action to help another person. Since these are integral emotions to the decision, this makes sense. Indeed, when people feel stronger empathic concern for targets they are more likely to help (Batson, Ahmad, Lishner, & Tsang, 2002), and when people are more likely to feel empathic concern on a day-to-day basis they are also more likely to help others (Davis, 1983). In order to test whether higher-arousal

positive emotions lead to increased helping we need to first identify a low-arousal positive emotion and relevant higher-arousal comparisons: contentment is lower arousal compared to happiness and pride. If higher arousal positive emotions lead to an increased likelihood of helping others then happiness should lead to more donations than contentment. This could easily be tested via emotion inductions, recording baseline emotions, or making content people higher in arousal through arousal manipulations (e.g., Vickers & Preston, in prep). The feelings elicited by heroic charities did not map onto specific emotions as well as those from nurturant charities. Heroic charities made people feel more "alarmed, activated, and vigilant." We have a working hypothesis that males imagine themselves in the shoes of the helper more than females, and that this leads males to feel more personal distress in response to heroic charities that perform activities with high risk of personal harm. Confirmatory testing of this hypothesis is ongoing.

To summarize, we found that appraisals, manipulated via specific emotions, appraisal dimensions within emotions, combinations of emotions, and framing can all lead to shifts in consumption decisions. Participants who felt negative and a high-arousal emotion, anxiety, acquired and consumed more. Conversely, participants feeling positive and high-arousal emotions, compassion and sympathy, gave away more of their resources to others. We have not explored this divergence between positive and negative emotions in consumption patterns, but understanding it is important in order to help people reduce their environmental impact and stresses associated with consumption. Since feelings of warmth and sympathy toward others leads to increases in charitable donations, it seems plausible that similar feelings toward the Salvation Army would make people more likely to donate their old objects so that others can reuse them. Examining this flip side of consumption regarding how people choose to donate and

help others, including the affective factors associated with them, is critical to achieve a better understanding of consumption and create a more sustainable world.

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